Defense Productivity Process Improvement (Phase II)

Defense Enterprise Integration Services

DoD Work Measurement/Labor Standards Redesign and System Architecture

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EXECUTIVE SUMMARY

The first phase of the Defense Productivity Process Improvement (DPPI) Project addressed the Defense Productivity Program as a whole. It produced a recommended redesign from improving "productivity" to "managing performance" This supports the current approach by management to shift the emphasis from planning and justifying resources to looking at total results. The most critical aspect of this approach involves on-going assessment (oversight) and feedback based on analysis of the comparison of projected quantitative expectations and actual results. As such, it is a continual improvement management mode.

Management of performance requires various kinds of support. Two particular types of support are (1) an integrated set of management improvement programs and tools and (2) solid data about the work to be performed, the time required and the manpower required. Phase I addressed the integration of management improvement programs in general. Phase II addressed the second type of support.

The focus of the second phase of the DPPI Project was to redesign the Work Measurement/Labor Standard program, which is a specific aspect of enhancing performance, and develop a general architecture for standardizing automated support for industrial engineering techniques. The first step of DPPI Phase II was to describe and analyze the current situation and automated tools used in the work measurement discipline. Based on this analysis opportunities for improvement were identified and recommendations for improvement were made. The results of this effort are recorded in Section 2 of this report. A major outcome was the expansion of the scope of this phase to include staffing/manpower standards along with labor standards and to combine them into one standard—a "work standard" (the work to be done along with the time and the manpower required to do the work).

In the second step, the work measurement discipline was redesigned as "Defense Performance Engineering Support" DPES. This combines the traditional work of developing labor standards and manpower standards/requirements with the newer efforts of providing process improvement, economic analysis, quality programs and organizational improvements. These items together become a comprehensive engineering consulting type service. DPES not only (1) provides data on required time and manpower to perform the identified work -- data which can be used by managers in determining performance expectations (estimates, schedules, work instructions, resource requests, budgets, etc.), it also (2) assists managers in tracking results and performing variance analysis of expectations compared to actual results, and(3) provides work analysis and continual improvement assistance. The results of this redesign effort is documented in Section 3 of this report.

In order to provide improved and standardized automated support to performance engineers in the development and maintenance of work standards, a high level architecture (requirements) of such an automated support system was developed. This type of system is needed to increase the ease and speed in developing work standards (i.e., reduce cost and expand availability). Section 4 of this report contains the general design for a Work Standard Application Package (WSAP) which supports analyzing and

measuring work and developing and maintaining work standards. The heart of the WSAP is the Work Standard (WS) Builder—a menu driven application for quickly developing work standards and a database for storing standard data and developed work standards.

Section 5 of this report presents various alternatives for implementing both the redesigned processes and the automated support. The alternatives for implementing the WSAP system are described, analyzed and evaluated. The basic recommendation is to develop the WSAP system requirements (architecture) to near production specifications and then evaluate commercially available products to support these requirements. If such a product is identified, then it would be adapted for use as the common DoD WS Builder and specifications. If no such product is found, then the production specifications will be completed, a prototype will be developed (WS Builder) and made available to customers (as the DoD common/standard design) for implementation on an "as need basis". With a standard design, all systems can share work standards and related data while permitting adaptation to local and central management systems. Once the WS Builder is selected/developed as the central piece of the WSAP system, then automated front tools can be identified and integrated into the WSAP to support various work measurement and analysis techniques and transfer this data electronically to the WS Builder.

The redesigned Defense Performance Management and Defense Performance Engineering Support not only provide the basis for a new management style and a new business service, they also provide the basis for new DoD policy and guidance for enhancing performance and providing work standards. They also will be integrated into a new DoD Defense Performance Engineering Program to promote more effective management and management support from process improvement and work standard resources.

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PROVIDING PERFORMANCE ENGINEERING SUPPORT

Final Report for

DOD WORK MEASUREMENT/LABOR STANDARDS REDESIGN AND SYSTEM ARCHITECTURE

1. INTRODUCTION

This document is the final report of the Defense Productivity Process Improvement (DPPI) Project, Phase II which addresses the improvement of work measurement and the use of labor standards.

1.1 Background

The first phase of the DPPI Project addressed business process improvements for the Defense Productivity Program as a whole and the lack of overall integration and coordination among the many available management improvement programs and tools used in the DoD. As a result a recommended redesign from improving "productivity" (efficiency) to improving total "performance" (efficiency, effectiveness, and process) through "managing performance" was developed. This redesigned concept provides the basis for developing a new comprehensive DoD policy for performance (results) management and the re-issuance of DODD 5010.31. _(The results of this effort are contained in the DPPI Phase I report, "Baseline Analysis and Improvement Recommendations: A Comprehensive Report of Findings and Recommendations", February 23, 1996.)_

The second phase of the DPPI project (DPPI Phase II) supports a commitment made by Dr. Edwin Dorn, Under Secretary of Defense Personnel and Readiness, to respond to the Inspector General's (IG's) concern about the Management of Labor Standards at Aeronautical Depots (Audit Report No. 95-049) by developing and implementing a comprehensive policy on work measurement and by completing the standardization of automated industrial engineering techniques. The DoD IG raised these concerns based on the findings of several audits of maintenance depots (specifically those findings addressed in Audit Report No. 95-049, December 8, 1994).

Based on these audits, the IG identified the following issues and recommendations:

- The development and use of work measured labor standards at the depots is currently inadequate.

- There is a need for new and comprehensive policy regarding work measurement and labor standards.

- There is a need for the development of standardized automated industrial engineering techniques.

This is not the only time that these issues have been brought into the forefront. Other studies, particularly an Office of the Secretary of Defense (OSD) task force study in 1992 and a 1995 Logistics Management Institute (LMI) study of Navy depots identified similar

issues and made similar recommendations. These recommendations included developing updated guidance on the nature and use of labor standards and developing a standardized automated system in support of the development and use of labor standards. The end result of this phase of the project is to propose alternatives that will assist in developing and issuing a new comprehensive policy regarding the use of Work Measurement/Labor Standards (WM/LS) and standardization of automated industrial engineering techniques, thereby assisting Dr. Dorn in fulfilling his commitment to the DoD IG.

Sources of additional background information (guidance, audits, reports, articles, and books) are listed in Appendix A.

1.2 DPPI Project Phase II Purpose

The purpose of Phase II of the DPPI Project is to propose alternatives for:

- a redesign of the development and use of Work Standard (WS) (labor and staffing standards) as a value-added tool for performance management

- a general architecture for a standardized automated system to support the improved development and use of WS

The objective of DPPI Phase II is to develop options for implementing improvements in WM/LS that are based on improved/redesigned processes for WM/LS and include alternative packages for an automated support system.

A special emphasis has been placed on relating work measurement/WS to the comprehensive world of performance management. Work measurement WS are viewed as one specific tool to support managers when managing performance (total results) in their area of responsibility.

Based upon the approval of a process redesign and architecture, new guidance for the development and use of WS will be written and issued. In addition decisions will be made relative to the development of a common automated system to support the development and use of WS in DoD by its components.

1.3 The DDPI Phase II Process

The first step was to analyze and document the current (As-Is) process of the WM/LS program to create a baseline. A component of this analysis was the development of a "case for change" that documents opportunities for improvement along with recommendations for improvements. The results of this baseline analysis is contained in Section 2.

The second step involved developing a proposed improved (To-Be) WM/LS program. Based upon extensive research, interviews and a workshop with Subject Matter Experts (SME), a new concept of "Defense Performance Engineering Support"(DPES) was developed. In addition, an analysis was done of the potential implications of this new concept. Details of the proposed redesign are presented in Section 3.

The third step involved designing a general system architecture for automated support of the development and maintenance of WS—a Work Standard Application Package

(WSAP). This architecture describes the basic components, functionality and requirements of the WSAP necessary to support the development of a work standard and the approaches for its implementation. The system architecture for the WSAP is described in Section 4.

The fourth and final step involved developing various alternatives for implementing the redesigned concept of Defense Performance Engineering Support (DPES) and the automated support system of WSAP. These alternatives, along with evaluations and recommendations, are presented in Section 5.

2. BASELINE WM/LS ANALYSIS AND RECOMMENDATIONS

2.1 Introduction

The first step of this second phase involved establishing a current baseline of the Work Measurement program and identifying recommendations for its improvement. This Section provides the context environment for WM/LS, a description of the current processes for "Develop WS" and a "case for change". To accommodate the wide spectrum of standards for time and manpower used within the DoD, the phrase "WS" has been coined to include labor standards, staffing/manpower standards and related forms of work measurement. This term is discussed in more detail in Section 2.2, WM/LS Context Environment.

Phase I of the DPPI effort established the overall approach for shifting DoD from a productivity paradigm to a performance paradigm. The result of that Phase I work provides a basis for future guidance for implementing performance (total results) management in the DoD. It is in light of this shift to performance management that the processes of developing and using WS are discussed and defined.

2.2 Work Standard Context Environment

There is some confusion (both in the DoD instructions and in current usage) regarding the meaning of the terms "labor standard," "staffing standard," and "process improvement." There is also some confusion (both in the instructions and in current usage and application) as to the relationship between the three. In an effort to understand how these terms and their relationships are used in the context of this report, the following Sections describe the definition and uses, labor standard, staffing standard, uses of standards, and process improvement programs. These Sections will also serve as a basis the development of a definitive description for the proposed environment.

2.2.1 Definitions and Uses

There is no stated definition for *labor standard* in DODI 5010.34, however DODI 5010.37 provides definitions of four terms for what is commonly referred to as a *labor standard*. A vague reference to *staffing standard* may be implied in DODI 5010.34 when referring to "higher" level standards. DODI 5010.37 provides a definition for *staffing standards*. The most comprehensive definitions that could be found in the current guidance have been used. *Process Improvement* is not defined in any of the guidance.

2.2.1.1 Labor Standard

The Engineered Performance Standard (EPS) as defined in DODI-5010.37 will be used for labor standard:

> *"The time a trained worker or group of trained workers, working at normal pace, takes to produce a prescribed unit of work of an acceptable quality, according to a specified method, under specific working conditions. It is derived from a complete, objective analysis and measurement of the task by recognized work measurement techniques with a stated degree of*

statistical reliability and includes allowance for personal needs, fatigue, and delay."

The current classifications of labor standards are:

- Class A: Engineered Standards are based on methods of time measurement, detailed time and motion studies, standard time study data, and statistical work sampling. Class A standards must be reviewed/updated every three years or they will automatically be re-classified as Class C.

- Class C: Non-engineered standards are primarily based on technical estimates, time studies and other techniques that do not qualify as Class A

As used in this report, *labor standards*, unless otherwise specified, includes both engineered and non-engineered standards.

2.2.1.2 Staffing Standard

The following definition is taken from the DODI 5010.37:

"A DoD Component-approved, quantitative and qualitative expression of personnel requirements. It identifies the human resources needed to do prescribed tasks and activities at varying levels of workload volume."

2.2.1.3 Uses of Standards

Figure 1 below lists the types of and uses for labor and staffing standards. Both are used to determine manpower requirements and cost estimates. The principal difference lies in the type of functions and positions where each is directly used. Labor standards are mainly used in manufacturing, repair and maintenance type work, in logistics depots and in other areas where direct ('touch') labor accounting is used. Staffing standards apply mainly to all other personnel positions and to indirect accounting for work. Normally, labor standards are used in the on-going management of production work. On the other hand staffing standards are used by higher level (work center, installation, command) management for yearly staffing requirements and evaluations and periodic redistribution of staff. Though staffing standards could be used in on-going management of work production of indirect personnel, currently indirect personnel time is not accounted for by work tasks.

LABOR STANDARDS	STAFFING STANDARDS	BOTH LABOR AND STAFFING STANDARDS
Establish costs for workload bids	Establish costs for workload bids	Plan mission manpower
Plan workload/Buy workload	Redistribute personnel and/or workloads	Analyze variance and identify corrective action
Schedule workload and resources	Decide training and training documentation	Articulate relationship of "Work Center performance measures" to "readiness"
Balance workload and resources	Justify manpower requirements	Determine cost and yield rate.

LABOR STANDARDS	STAFFING STANDARDS	BOTH LABOR AND STAFFING STANDARDS
Control work and re-distribution of resources	Execute mission with people on hand	Provide opportunity to consult for improvement
Measure performance		Contribute to operation of simulation models
Assess effective use of resources		Establish target numbers for measuring productivity/performance, then assess variance.
Evaluate process alternatives		

Figure 1: Labor and Staffing Standards

2.2.1.4 Process Improvement Programs

There is no formal definition in the current productivity guidance for "process improvement" programs. There are, however, detailed definitions for process improvements in other DoD programs such as: Functional Process Improvement (FPI), Business Process Re-engineering (BPR), Value Engineering, Total Quality Management (TQM), etc. These definitions are found in DPPI Vol. I, and could be used as a baseline for a definition for a process improvement program. DODI 5010-34 states that there is a requirement for "improving methods of doing work" prior to establishing a labor standard. DODI 5010.37 outlines general procedures for performing an Efficiency Review (ER). An ER is a major study and analysis of an organization's structure and processes undertaken to determine the optimal mix of process resources required to accomplish the given workload and be a Most Efficient Organization (MEO).

Though there is no formal definition, *process improvement programs* are formal and informal efforts used to improve the way a process is accomplished. The word *process* refers to any effort which produces a product(s) or service(s) ranging from complex processes (i.e., building a F-16) to simple processes (i.e., opening the mail). *Improvement* refers to performing a process more efficiently than it is currently being performed. Improvement is determined by evaluating the following areas: time, cost, quality, work satisfaction, customer satisfaction, etc. In general, process improvement programs focus on increasing the performance effectiveness and efficiency of all units, both individually and in aggregate.

Process Improvement Programs may be used in:

- Developing new automated information systems
- Developing more effective and efficient ways of doing business
- Preparing labor and staffing standards
- Preparing resource requirements
- Reducing costs and/or manpower

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- Responding to new business environments and/or customer demands
- Resolving a problem in performance

2.2.2 Development and Usage Overlap

The Venn diagram shown in Figure 2 illustrates the current relationship of labor standards, staffing standards, process improvement programs and other related efforts. Each area is presented by a circle. The overlap of circles represents the intersection of these areas. Each circle and area of overlap is numbered for discussion.
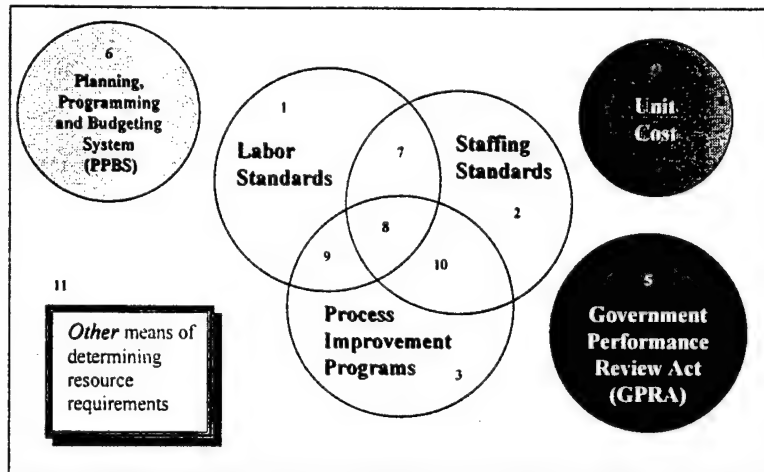
Figure 2: Ways of Improving and Measuring Productivity & Performance

The following paragraphs discuss Figure 2.

- <u>Area 1</u>: Labor Standards can be developed/updated independently of staffing standards and without performing process improvement. They may be used alone to estimate, plan, schedule and control workloads, prepare manpower and cost estimates, and to evaluate work performance.

- <u>Area 2</u>: Staffing Standards can be developed/updated independently of labor standards and without utilizing process improvement programs. They may be used alone to estimate and, on a gross level, to evaluate manpower requirements.

- <u>Area 3</u>: Processes may be improved without using any labor or staffing standards.

- <u>Area 4</u>: Unit Cost is the cost to produce one unit of output. It is calculated by dividing the total cost of production by the total units produced. It provides a gross overall indication of efficiency with no traceable relation to labor standards, staffing standards or processes.

- <u>Area 5</u>: The Government Performance Review Act (GPRA) focuses more on output and outcome and does not specifically support standards and process improvement on the highest level.

- <u>Area 6</u>: Planning, Programming and Budgeting System (PPBS) is the official resource management system of the DoD. While some data used in this system

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may, at some point in its history, have used labor standards/staffing standards as part of its calculations, there is no required or traceable link to WS. Nor is there any relationship between the PPBS and process improvement.

- <u>Area 7</u>: Some methods/techniques for the development of staffing standards employ labor standards.

- <u>Area 8</u>: The area where both labor and staffing standards are used to support work process improvement,, where the development of labor/staffing standards results in the improvement of processes, and/or where improved processes result in updated labor/staffing standards.

- <u>Area 9</u>: As stated in DODI 5010.34, the development of labor standards requires prior improvement of the work process. However, in practice the development and use of labor standards cannot wait for the authorization and implementation of process improvements (which may never occur). On the other hand, DODI 5010.37 requires the use of labor standards in the analysis and update of a process. If no standards exist, then they must be created. In practice, most of the time, a change in one standard results in a change in another standard

- <u>Area 10</u>: The relationship of process improvements to the development of staffing standards is not specifically explained in the current guidance, though, ideally, good staffing standards should be based on improved processes. However, in practice, the development and use of staffing standards cannot wait for the authorization and implementation of process improvements. On the other hand, DODI 5010.37 requires the use of staffing standards in the analysis and update of a process. If no standards exist, then they must be created. In practice, most of the time, a change in one standard results in a change in another standard.

- <u>Area 11</u>: These are all the other standards or methods for determining other sources of resource requirements including material, facility, and equipment resources. While there are "material standards," "facility standards," "equipment standards," and other standards, these are normally established outside of the work function being resourced. For example, material standards are established based on the requirements of the end-item being serviced or based on general safety requirements. Facility standards are established by local zoning laws or based on Service developed specifications. Equipment standards are established by manufacturers or based on technical manuals. These other "standards" are most often used by engineers and managers in planning and making resource considerations. While these standards may inform some of the conditions for labor or staffing standards, they are not developed in the process of creating labor or staffing standards.

2.2.3 Interrelationship

Figure 3 is an IDEF0 diagram, For Exposition Only (FEO), which details the management structure and dynamic flow between these areas discussed above. In addition, it illustrates how these areas fit within the larger context of plan, do, check(or study) and act. The "Develop Work Standard" (A1) box (described in more detail in Section 3) has been given autonomy to show its relationship to these management functions. This diagram

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provides a bridge to the DPPI Vol. I models and links the lower level decomposition of the standards development process. There are many issues a manager must address with respect to the use of standards. The following paragraphs explore these issues.

The conditions and assumptions of this diagram are artificially manipulated. This is illustrated by the fact the "Develop Work Standard" (A1) box could have been incorporated into the "Improve Process" (A5) box or into the "Plan Work" (phantom) box. By the same token, not all of the management functions are described to their full extent. For example, "Apply Work Standards" is a sub-process within the larger process of "Plan Work", hence the phantom box. Also "Assess Work Standards" is an activity within "Develop Work Standards" because of Industrial Engineer (IE) support, and is linked functionally to the manager's larger role in "Assess Work". "Do Work" is shown here because it provides the data which is used in the assessment process.

These high-level activities are described as follows:

- *Develop Work Standards,* the primary focus of this Project, includes the specific steps required to produce labor and staffing standards.

- *Apply Work Standards*, is the manager using labor and staffing standards to perform manpower estimates and cost projections, distribute and schedule workloads, and prepare/provide justification for the budget. It also includes the use of standards in preparing and/or assessing contracts for outsourcing.

- *Assess Work Standards* (a process within Develop WS) is functionally part of the larger management task of "Assess Work" (the phantom box). It has been modeled separately at this point to show its close relationship with the basic management function of monitoring, analyzing, and evaluating work performance. It also provides the necessary feedback for maintenance of labor and staffing standards.

- *Improve Processes* ranges from small changes in a procedure to structured change programs such as Efficiency Reviews (ER), Business Process Re-engineering (BPR), etc. It connects WS and process to identify areas for improvements. The generic output of "improvement report" incorporates any and all reporting of process improvement efforts from ER reports, MEO documentation, BPR, Commercial Activity (CA), Activity Based Costing (ABC), and Functional Economic Analysis (FEA) reports, to inter-office memo's on procedural improvements being made.

Figure 3 represents a possible configuration based on input from 'productivity technicians' (Industrial Engineers [IEs] and Management Analysts [MAs]) and current guidance. How well these activities are activated in actual operations by the Components will require validation. The purpose here is not evaluation, rather it is to show the interrelationship of the activities under consideration.
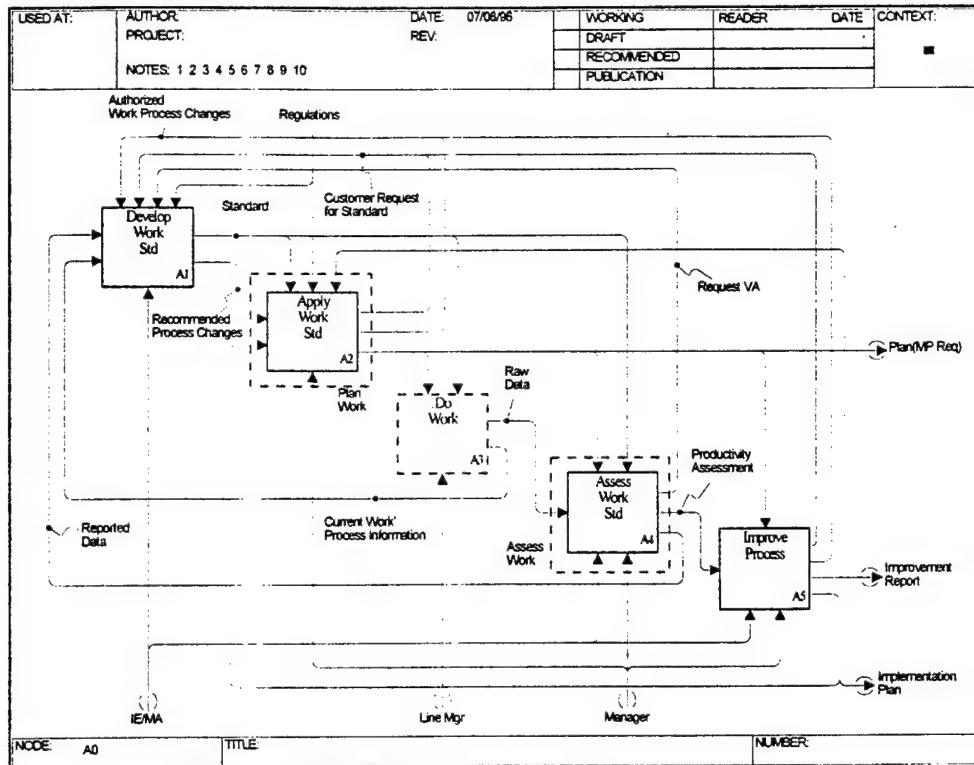
Figure 3: Work Standard Context Environment

2.2.4 Taxonomy of Methods

The primary difference between one work standard and another is not their name or classification, but rather is the technique or method used to develop the standard along with the resulting level of precision. The method selected for developing a set of WS is influenced by a combination of factors. One factor is the type of process being measured. Another factor is the level of data accuracy and reliability needed. Other factors include available time, money, staff and requirements for the development of WS.

Rather than identify a particular method to be used in a particular case, it may be helpful for managers to select the most appropriate standards development option for them, based on the constraints above. This would require a decision support capability to take advantage of optimization, but general guidance could be beneficial in the near term. In an effort to provide assistance in such a selection, a taxonomy of methods needs to be established. This taxonomy will help in the development of standards which can be cross referenced to various types of work for which the method is most applicable. A preliminary attempt at such a taxonomy is provided in Figures 4 and 5. (Figure 4 is based on an article by Royal J. Dossett in Industrial Engineering, April 1995 pg. 21ff. Figure 5 is based on techniques from the Army's "12 Step" process for determining manpower standards.)

Labor Standards

Type of Task / Method of Measure	Very Short, Repetitive	Short, Repetitive, Variable	Longer, Variable	Long, Repitative, Variable	Seldom Performed, Variable
Predetermined Motion (Analysis) Times Systems (PMTSs)*	X	X			
Time study [1]		X	X		
Micromotion	X				
Multiminute Measurement		X			
Work (Activity) Sampling [2]			X		
Professional Measurement				X	
Historical				X	
Estimates					X

1 including leveling or rating
2 ratio delay

* PMTSs:

Methods Time Measurement (MTM)
Work Factor
Maynard Operation Sequence Technique(MOST)
Modular Arrangement of Predetermined

Time Stds (MODAPTS)
Master Standard Data (MSD)
Motion Standard Times (MST)
Master Clerical Data
Basic Motion Time

Figure 4: Labor Standard Methods

Staffing Standards

Type of Task / Method of Measure	Very Short, Repetitive	Short, Repetitive, Variable	Longer, Variable	Long, Repitative, Variable	Seldom Performed, Variable
Purely Positional [1]			X		
Composite Workload		X	X		
Purely Workloaded	X				
Modeled [2]			X		
Functional Analysis [3]			X		
Through put analysis				X	
Chocolate Layer Cake [4]					X

1 directives, ratios, practices
2 military police
3 linear regression y=a+b1x1+b2x2 Y=a+bx
4 f(origin, year)

Figure 5: Staffing Standards Methods

2.2.5 Conclusion

Measurement of work and the development of labor standards is a highly disciplined specialty within the field of Industrial Engineering. The techniques of measuring work and developing labor standards are most applicable to repetitive, touch labor, and/or routine type work, such as those standards found in manufacturing. Staffing standards, on the other hand, are part of the field of human resource management; and their development/use is not as highly refined or disciplined as labor standards. Currently in DoD, labor standards and staffing standards are developed by different "shops" with different "clientele". In DoD, labor standards apply only to a very small portion of overall DoD functions, workload and positions—mainly direct labor work in depots, manufacturing sites and some installation engineering offices. Staffing standards apply to all DoD positions, when used. When developing overall manpower requirements, labor standards may be used when developing staffing standards for workloads covered by labor standards.

Though labor standards and staffing standards, currently, are fairly distinct in their development and use, both standards relate work, time and personnel and express that relationship with a numeric value. This numeric value is used to make various performance management calculations. As a result, this study combines them under the single term *WS*. In addition,, this study seeks to determine if these two standards can be combined into a single concept, approach and tool with respect to performance management; and if so, how this can be most effectively implemented.

2.3 Development of WS in DoD: Current Concept

2.3.1 Introduction

The first step in improving work processes is to describe the current work situation by establishing the baseline (the "before" picture). This baseline is used to make changes and measure improvements. In order to develop an accurate baseline, the way WS are currently developed must be understood. In addition, documentation of the current processes involved, the resources used, the outputs produced, the time involved and the interrelationships of all these components must also be analyzed.

In the BPR approach, the primary technique used to describe the current situation was IDEF0 (Activity Modeling). The diagrams and definitions which describe the current process of Developing Work Standards are found in Appendix B. This sub-Section of the report will present the methodology used to develop the current concept, discuss the usage and quality of this methodology, present the strategic statement for DEVELOP WORK STANDARDS, and finally provide a textual description of the current concept/process of DEVELOP WORK STANDARDS.

2.3.2 Method of Development

The analysis began with a review of Government Furnished Information (GFI) in the form of DoD Directives, Instructions, Manuals, and Standards. Other GFI included Inspector General reports and study reports on the use of labor standards in Military Depots. Additionally, books and articles from the industrial engineering community were reviewed. Based on this literature review, a preliminary IDEF model was developed.

The concept and the model were further refined through discussion and input of the DPSO staff.

In addition, two workshops were held with DoD component personnel involved with the development and use of WS (SME). This provided the project first hand, expert input used to assist in the formulation of the current concept for developing WS. Based on the information collected from these two workshops and further input by the DPSO staff, the model of the current (As-Is) processes for DEVELOP WORK STANDARDS was refined to its present state. *(It needs to be understood that the BPR approach is an iterative process. Therefore the As-Is Process Model is open for updating as a result of reviews by SME, interviews with users of WS and visits to sites where WS are being applied.)*

2.3.3 Usage and Quality

In addition to providing a baseline from which improvements will be identified and made, this description (model) provides a validation and demarcation of the scope of this project. Not only does this description provide an understanding and explanation of the current concept/process, it is used to identify Opportunities for Improvement (OFIs) and to make recommendations for change. The current level of detail provides the information necessary to analyze the usability of the current concept, its problems and suggestions for change. This information is necessary in order to proceed to the next step in BPR—the description of the improved (To-Be) concept/process for DEVELOP WORK STANDARDS.

It should be noted that this As-Is model DEVELOP WORK STANDARDS, only shows the development of WS and the processes used by productivity technicians (IEs/MAs) in doing so. The model does not show the processes followed by the "customer"/manager when using work standard values in making calculations for planning, estimating, scheduling, analyzing, problem solving, control, determining manpower requirements, etc. Additional information missing from this report includes the understanding of the manager's requirements for WS and their feedback on the description and analysis of existing and future WS. However, the model is complete enough and the basic problems identified to the extent required to meet the goals of this report . The next step is the development of the To-Be concept/process. This process will address the use of WS and include the input of the "customer"/manager/user. The current model provides the clarity and impetus to involve the users of WS in the development of the improved process. These users will participate in formulating the To-Be process, and as a result the As-Is description will be updated based on their input. As noted above, this is an on-going, iterative process and the document is a living document.

2.3.4 Strategic Statement

A Strategic Statement provides the rationale for a business process as well as the boundaries of the process. It includes the vision of the business process, its mission and goals, and its scope. The following Strategic Statement for DEVELOP WORK STANDARDS was developed during a workshop with SME and DPSO staff and edited for this report.

2.3.4.1 The Mission

The mission of the business of Work Measured Standards—DEVELOP WORK STANDARDS—is to provide WS and quantitative data/information (time, work units produced, personnel involved) to managers (field level, primary staff level, functional managers, resource managers) for use in:

- Planning
- Scheduling
- Control of work
- Estimating cost
- Determination of manpower requirements
- Allocation of manpower and other resources
- Evaluation of alternative processes, procedures, equipment or organizational arrangements
- Support of the Defense Business Management System (DBMS)

2.3.4.2 Vision

For DEVELOP WS, the vision is that line workers, managers, and organizations will be able to do their work better, faster, and cheaper, using common sense.

2.3.4.3 Scope

The process of Develop WS begins with a requirement or a request to develop WS and ends with the issuance of WS. In addition, evaluations and validation of work data are also major aspects of the on-going process of maintaining WS. The major WS produced are labor standards and staffing standards. These are standards which deal with work time for personnel or "work time standards." Though the specific procedures and methods for developing each type of standard are different, the general steps are the same. Though WS are supported by, as well as provide support to, improvement efforts (ER, Commercial Activities, BPR, TQM, etc.), the improvement process is a separate process (step) form the process of developing WS.

2.3.5 Process Description

The current process of Develop Work Standards is described using the IDEF modeling technique. The diagrams and definitions (descriptions) are presented in detail in Appendix B. Presented here is a brief summary of the current process DEVELOP WORK STANDARDS and the component processes involved. For an overview of all these component processes and their hierarchical relationship see the node tree diagram, Figure 6. The IDEF hierarchy notation will be used here to identify each component process.
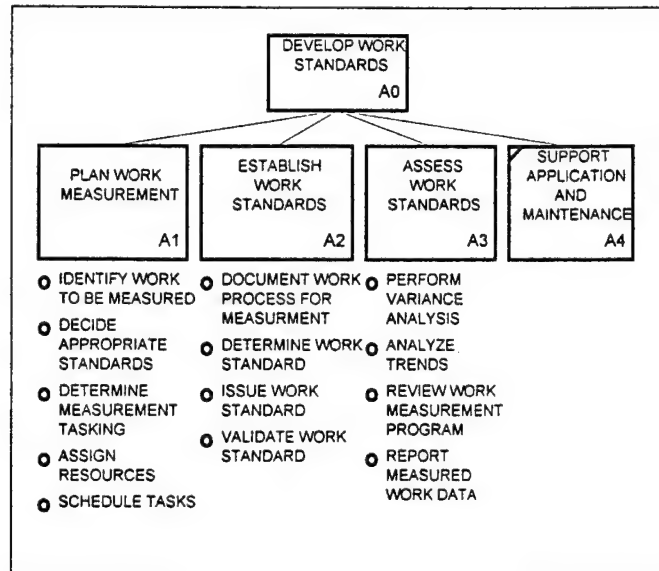
Figure 6: As-Is Node Tree

2.3.5.1 A0 - Develop Work Standards

This is the total activity of developing and maintaining standards of work time—both labor standards and staffing standards. It includes the activities of planning the effort of work measurement, establishing the standards, assessing WS, and conducting annual application and maintenance (specifically for staffing standards). This effort is initiated either by some authorization/requirement from higher authority to develop standards and/or from a request by a manger for the development/update of standards. While the development of WS often is preceded by process improvement as well as contribute recommendations for process improvement, the activity of making improvements in work processes is a separate activity. This relationship is shown in the context diagram of the IDEF model - A-0. (Figure 5 in Section 2.2.4 above.)

2.3.5.2 A1 - Plan Work Measurement

This the activity of planning for the development and maintenance of WS and related activities. Basically the productivity technician and the manager (customer) clarify and agree upon the area of work for which standards need to be developed/updated and upon other related requirements. Once the scope of work has been defined, the following must be determined:

- The most appropriate (value added) type of standard to be developed

- The level of detail at which it will be developed

- The level of accuracy needed

- The method used in developing the standard

- Other issues of feasibility

Once the standard type, level, and method have been determined, the tasks involved are then broken out with designated milestones. Resources to accomplish each task are

assigned and the tasks are put on a schedule. All these actions comprise the plan for a specific program, effort or study for developing a set of WS and approaches for managing the. This plan serves as guidance on all the other activities involved in developing WS.

2.3.5.3 A2 - Establish Work Standard

This activity involves documenting the work process for which the standards are to be developed. The process must be broken down into specific, discrete steps and documented so that it may be properly measured according to the method used for developing standards. Such documentation should also describe the relevant conditions, equipment, layout, facility, environment, and any other factors which influence the execution of work. This documentation is developed based on input from functional users (worker, managers, etc.). If the processes have already been described, (i.e., in a process improvement effort, handbooks, or by previous standards) then this description is used to determine future WS.

Once the process has been adequately described, the method of standard development is applied and the standard is determined. *(It should be noted that in the activity of documenting a process and determining the standards, opportunities for improvements may be discovered and recommendations for changes will be passed on for action.)*

After the standard has been determined, it is issued either by means of publication and/or entry into an automated information system.

These standards are then validated by initial application and/or by analyzing how successfully they were applied to new or different situations (locations). Modifications, adjustments or exceptions may need to be made to adjust for differences among particular situations/locations.

2.3.5.4 A3 - Assess Work Standard

This is the participation of WS in the "assess" dynamic of management. It is the activity of monitoring, analyzing and evaluating the program of developing and maintaining WS including all aspects of reviewing the program. It also includes all activities of assessing the quality and validity of WS through variance analysis. Certain trend analyses use WS as part of the analysis. Data captured in the automated systems for the development and use of WS is employed in reporting resource usage to larger resource management systems. This data is often validated by WS personnel.

2.3.5.5 A4 - Conduct Annual Application and Maintenance

Staffing standards are applied annually to an organization, function or program to analyze and evaluate manpower utilization, trends, projections and requirements. At this time, the standards are evaluated and updated as necessary.

2.4 Case For Change

The ability of DoD to effectively implement and use WS for their intended purpose has yet to be realized. Although arguments are convincing for the development and use of WS, managers have not institutionalized these tools in their performance management processes. This Section analyzes the reasons for the current state of WS and makes

recommendations for improving the work measurement program within DoD. Improving the work measurement program will contribute to improving the efficiency and effectiveness of performance by managers at all levels. First, OFIs describe the weaknesses in the current development and use of WS. Second, *Recommendations for Change* discuss ways to improve the development and use of WS.

This *Case for Change* is based upon the results of the first two workshops held during the project. The participants not only validated problems, issues and recommendations identified by previous reports and studies, they also identified many other problems, concerns and recommendations for improvement. Their contributions are summarized below.

2.4.1 Opportunities for Improvement

Following the maxim of "If it isn't broken, don't fix it," the development of OFIs identify where the current process is "broken." They identify problems, issues and concerns about current operations of a process. While analyzing and modeling the current process of Develop Work Standard," several problems, issues and concerns were identified. The following chart organizes the problems into six general categories of OFIs and includes a preliminary analysis of the underlying or "root" cause for each OFI. Often the problems, issues and concerns are symptoms of a more basic or fundamental problem. Hopefully, a few common root problems will emerge. In addressing these few root causes, the many symptomatic problems, issues and concerns can be resolved.

Following the chart, each OFI will be discussed.

OPPORTUNITIES FOR IMPROVEMENT	ROOT CAUSES
1. Weak Enforcement: Weak, outdated, or rescinded mechanisms (guidance/structures) for ensuring development and use of WS. No clarity as to 'when', 'where', and 'what' for the development and use of WS. De-emphasis of WS because of TQM and Unit Cost.	-Standards not tied to receiving, managing and keeping resources. -Inadequate program review by OSD or Services and weak enforcement of good management practices. -Government "culture" is not conducive to efficient and effective performance

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2. Inconsistent automated data support for development and use of standards (various systems of various degrees of adequacy) Poor quality of work standard data non-standardization of methods for developing standards great variation in quality of existing standards and their development variety of unrelated automated industrial engineering techniques or systems Time delay and quality of reports hinder effective use of work standard related data in managing.	-Many non-compatible systems within and between Services. -System not connected with (resource and/or decision) management and financial accounting systems therefore standards related data are not required for management (and often not available if desired).
3. Misperception of WS by managers. For a variety of reasons managers do not understand when, where, why, or how to use WS effectively Little concern to use WS to manage The use and results of WS is seen as "bad news" by managers. Bottom-line concern to 'get the product out the door' with poor understanding or skill in how WS could help	-Weak or non-existing marketing by WS people (weak promotion of the value-added by use of WS).
4. Limited positive incentive to improve performance	-DoD "budget culture" does not reward effective and efficient management. (Your dollars and personnel will be reduced if you improve.) -Reluctance of the Government to provide financial incentives to managers and workers for improvement of performance.
5. "Engineered" and "Non-engineered" are inadequate as work standard categories "Engineered" is too strict "Non-Engineered" is too lose. "Engineered" labor standards are limited for value-added use.	-Policy does not provide guidance for flexible creation and use of WS. -Guidance provides "instructions" rather than "regulations" and they do not provide level of detail variety of standards and related functions.

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6. Lack of trained personnel to develop, promote, and use WS Downsizing: no need or use for standard setters. Few resources in place to train personnel, particularly managers, in the development and use of standards.	WS are not a top priority for top managers, so they do not use their scarce resources to train and to provide staff in the development and use of WS.

Figure 7: Opportunities for Improvement

2.4.1.1 Weak Enforcement

Based upon analyzing IG reports, and studies and reports contributed by workshop participants, there seems to be little active use of WS by organizations and managers in planning, evaluating and accounting for production and related resources. One basic cause appears to be inadequate enforcement/use of WS. In other words, managers are not penalized for not using WS. Partly this is due to the current emphasis (guidance) upon Unit Cost and TQM which make no use of WS.

Another main reason is that feedback loops between planning, execution, and assessment of performance and between the various levels of management are either non-existent or are not required. As a result, there is little coordination between these aspects of performance management. In addition, managers at the various levels remain isolated from each other.. Rather than there being a coordinated partnership in performance, managers often experience cross purposes of goals planning for, control of, and accounting for, use of personnel and workload performance.

In addition, when WS are used in developing resource requirements, too often other factors are permitted to over-ride the facts developed from WS. Regardless of the reasons for these other factors, it undermines any incentive to use meaningful WS.

Besides not addressing the above problems, current guidance is weak or outdated, particularly at the OSD level and therefore does not provide adequate support and guidance for the development and use of WS in today's environment. This has been noted and discussed in the Case for Change Section of the Phase I Report.

Managers use the policy which mandates that process improvement is a required prerequisite for developing WS as an excuse for not developing WS. Their reasons include statements that process improvement takes too long, and is too expensive, processes change before the improvements are implemented, workloads are changed too often, or there is not enough time to do process improvement before the standards are needed. While these reasons may have validity, it does not seem to work well in practice.

In summary, with weak guidance and oversight, the use of WS can easily be ignored. In fairness, it must also be stated that there are noteworthy exceptions where WS are effectively developed and used in managing performance.

Root causes behind these problems of poor enforcement of good management practices are:

- The use of WS is not directly linked (by regulation and/or enforcement) to resource requirements and accountability. There is no tie between the development and use of WS and the primary concern and motivation of managers—receiving, managing, and keeping their resources.

- Inadequate program review (pro-active oversight) by OSD or the Services of the development and use of WS.

- Existing guidance, particularly at OSD level, for the development and use of WS is outdated and does not provide for strong oversight/enforcement.

- Government "culture", with its focus on justifying cost rather than controlling cost, is not conducive to efficient and effective performance. *(As such, there is not much of a 'market' for WS, regardless of the quality of the program and the standards.)* Whether this is a basic reality of the way governments need to function or a weakness which needs to be corrected, it exists in the current operating context. It is yet to be determined the exact impact the trend toward a "market economy" with privatization, competition, "fee for service," performance reviews, and downsizing will have upon government "culture." In the mean time, rather than 'fight' this culture, it must realistically be taken into account when developing guidance (requirements, oversight and enforcement) for WS.

2.4.1.2 Inconsistent Automated Data Support for the Development and Use of WS

There are various automated systems being used to support the development and use of WS. These systems vary in their effectiveness. (See Phase I Report: Case for Change and related Appendix references for a more detailed discussion of this OFI.) The following list indicates some of the problems with the existing automated systems:

- Poor quality of data

- WS related performance data which is collected and/or reported varies from organization to organization, even from year to year for the same organization; thus there is no validation or comparisons made of these data.

- Methods for developing WS have not been standardized

- The varied types and quality of WS or their development inhibits sharing and comparing of WS

- No standardization, commonality or sharing among the automated industrial engineering techniques or systems being used in the DoD.

- Time delay and poor quality of reports hinder effective use of work standard related data in managing.

Root causes behind these problems are:

- Many non-complimentary work standard systems within and between Services and there seems to be little impetus to develop commonality.

- Work standard systems are not connected with management (resource and decision) systems nor with financial accounting systems. Therefore work

standard related data is not required for management and thus no requirement for common and consistent data.

- Out-moded systems (batch systems, non-open systems, non-integrated real-time systems) do not provide timely and quality reports to managers.

2.4.1.3 Misperception of WS by Managers

Managers, according to first hand reports from interviewees, by and large, do not seem to be interested in using WS. *(It must be noted that there are shining exceptions of managers who do use WS and use them well.)* There seem to be several misperceptions that managers have relative to effectiveness and use of WS. These misperceptions contribute to the lack of interest in the use of WS. Some of these misperceptions are:

- WS are used to cut jobs and to promote downsizing.

- Focus is on time and does not consider other factors.

- See no value added (no 'bang for the buck') in using WS.

- WS are used for micro-management.

- WS are used to evaluate personal performance.

- People are not comfortable with, nor trust, statistics.

- Validity of the data is questionable.

- Use of WS is an 'old fashioned' way of measuring.

- Development of WS does not empower employees (an outside team develops the standard).

- The results of work measurement do not protect individuals and their jobs.

- WS are inflexible.

- With downsizing being forced on DoD, organizations must make do with what they have. Therefore, manpower requirements based on WS are meaningless.

As a result of these misperceptions, there is no real need for WS or for personnel to develop them.

Some managers regard the results of WS to be "bad news" and thus actively resist or subvert the use of WS.

For some managers, especially in depots, their only concern is to "get the product out of the door." Only some of the managers see the value of using WS in "getting the product out."

Some managers say that they have no need for industrial engineers and the labor standards program, but then complain when there is not labor standard data in their management system.

Root causes behind these problems are:

- Weak, or non-existent, active marketing by WS people to promote the value-added nature of WS and to counter the negative misperceptions with positive images of WS.

- Lack of a working (verses an intellectual) understanding , by managers, of the role WS play in planning, executing, assessing and improving production.

2.4.1.4 Limited Positive Incentive to Improve Performance

A concern expressed during this analysis was that managers did not make use of WS. The reason for this is that there is little incentive for managers to improve performance, and as a result there is little need for tools to help them improve.

People are motivated to make changes for two basic reasons—either they are forced to act to avoid painful consequences or they act in order to obtain a desired reward or benefit. In addition to the lack of enforcement of the use of WS there appears to be very little reward or real benefit to DoD managers when they use WS. In the commercial world, the profit motive (increase in performance results in increased profits, more customers, promotions, etc.) is an incentive to management to control costs and improve performance. Management uses WS to achieve these performance goals and control costs. On the other hand DoD managers have more pressing concerns (i.e., limited funding, justification of budget requirements, distribution of limited resources, and making personnel promotions) which take priority over any need to reduce costs and improve performance. Without real reasons to improve performance, there is little interest in developing and using tools which increase performance, such as WS. As noted in OFI-1 above, there is a trend toward a "market economy" in the DoD. This should provide some of the positive incentive to encourage managers to improve and use WS to manage such improvements. But the speed and extent of its impact is not yet clear. In the meantime, there appears to be very little personal incentive, outside of personal and professional concern for effective management, for managers to use WS to improve their performance. There are exceptions to this, but the overall climate and culture does not seem to provide much incentive to make use of WS.

There have been various "incentive programs" (e.g., Productivity Gain Sharing) which have provided financial reward to organizations and personnel for improving performance. However, due to the complexity of the programs, receipt of actual rewards that do not match promised rewards and because of occasional abuse, some of these programs have been discontinued. The bulk of current "incentive programs" are non-monetary and are established locally.

Managers are reluctant to make any changes that might result a job loss for "their people." The use of WS often reveals the need for less personnel. Without the management philosophy, policy and/or regulations which permit and encourage re-training and/or redistribution of human resources, job loss will continue to be a disincentive for the use of WS.

Root causes behind these problems are:

- The DoD "budget culture" mitigates against effective and efficient management and therefore against the use of any tools for effective and efficient performance. *(With the major concern of managers to retrain their level of resources—people*

and dollars—no one is encouraged to admit that they can do with less people and/or dollars or even to try to do better. In fact, they are affected adversely if they do.)

- Reluctance of the Government to provide financial incentives to managers and workers for improvement of performance.

- Lack of management policy to provide for human resource re-distribution before reduction in forces.

2.4.1.5 Inadequacy of "Engineered" and "Non-Engineered" as Work Standard Categories

Engineered labor standards are too strict, precise, and inflexible to be value added except in a vary narrow range of work. "Non-engineered" is so loosely interpreted that it provides little or no guidance in the development of labor standards. Also, standards developed as "non-engineered" are often too broad and imprecise to be of much value. Staffing standards, while having no standard classification, also share a broad range from highly sophisticated techniques of development to very gross estimates.

This OFI shows that these two categories are too simplistic to address the wide range of requirements necessary for WS, nor are they flexible enough to address today's uses of WS. While various techniques for developing labor and staffing standards are being used in a variety of situations, there is no guidance as to what range or level of sophistication and accuracy is appropriate for which particular function and/or usage.

"Engineered" labor standards are often too expensive and very time consuming to develop and maintain to be value-added for a manager. Also, they are applicable only to a very narrow range of DoD Component functions.

The Navy has instituted a Class B for labor standards which requires only documentation for the development of the standard rather than the specific, high level of accuracy required by Class A, "engineered", labor standards. But this is not yet DoD-wide policy.

Root cause behind these problems is:

- Current policy does not provide guidance for flexible creation and use of WS.

- Existing guidance for WS is "instruction" rather than "regulation" and does not provide any level of detail to match functions with acceptable methods of standard development.

2.4.1.6 Lack of Personnel Trained to Develop, Promote, and Use WS

With downsizing of personnel and with decreased emphasis on the use of WS, few people are being trained in the development and use of WS for managing work processes. Programs and staff for the development of WS have been drastically reduced.

With the emphasis on TQM, BPR, process improvement, and performance measurement, WS are not seen to have much of a role, if any. Therefore, few people are being assigned to establish the development and use of WS.

With limited personnel resources, the issue arises of what is the best method for organizing a work standard program and using personnel who are trained in the development of WS that will make the most effective contribution. One suggestion

focuses the program and its resources in a centralized location from which services are provided to all functions and managers in a service area. Another suggestion is to provide work standard developers as part of the management team in each function and/or location. The dangers are:

- WS developers are seen as "interfering outsiders"
- WS developers come under the influence of the local manager and are hindered from doing their job

Root causes behind these problems are:

- WS are not a high priority for senior mangers, thus they do not train staff in the development and use of WS.
- Focusing the use of WS in developing manpower requirements (which are often arrived at by means other than and in spite of the application of WS) rather than in managing performance.
- Managers who do not see the value and use of WS.

2.4.1.7 Summary

In review of the above problems (symptomatic and root), there are a few fundamental problems whose interrelationship tie all the above problems together.

- There is no common set/range of methods for developing labor standards nor for developing staffing standards which fit the various needs of managers for various workloads (types, size, duration) and various degrees of granularity of measurement.
- WS are not tied to resources, either in terms of requesting, accounting or managing them.
- Weak requirements, overview and enforcement of the use of standards.
- A weak concern to improve performance, fundamentally because of the government culture (justification vs. control and budget vs. profit) which does not encourage or reward performance improvement.
- No common automated work (performance) management system requiring the employment of WS. (Such a system would be a system for operational planning and management as well as the system for developing and managing the WS This system would also be linked to or part of a larger system that dealt with longer term planning, programming, budgeting [current and future years], control and accounting.)

The lack of the common automated work management system is the single root problem. Without this system, the use of WS:

- Creates an extra burden for the manager
- Means requirements and principles of management and WS are just nice theoretical ideas without practical grounding
- WS are not practical

- No linkage of standards to resources is practical or enforceable

On the other hand, with such a system:

- WS are required for the system to function

- The linkage is real while the requirement and enforcement is constant.

2.4.2 Recommendations for Change

This Section provides recommendations which may be used to guide the improvement of the WS process. These recommendations seek to pull together the analysis presented in the preceding Sections. Each recommendation is composed of a summary statement, a brief explanation, expected benefits, and a list of suggested improvements collected from the workshops and previous studies.

2.4.2.1 Guidance

Statement

It is recommended that updated, focused and consistent guidance be issued for measuring the time and personnel required to perform work processes, for setting of time/personnel requirement standards for those processes, and for using these WS. This guidance would be based on an improved concept and processes for the development and use of WS. It would include the following aspects:

- Provide managers with processes and tools, relative to WS, which would support the manager in managing rather than having to be concerned with another extra requirement. This would include a taxonomy (cross reference of a range of methods with types of work situations/functions) of WS from which the manager can create value-added WS.

- Provide the requirement to link WS to resource (planning, requesting, managing and accounting of them) management and to performance management

- Provide for frequent, pro-active oversight and enforcement as well as incentive programs

- Provide for flexibility in the development of WS along with a common set/range of methods for developing WS

- Provide Standard Operating Procedures (SOPs) for the development and use of WS which have an adequate level of detail to walk individuals through the process of selecting, developing and applying WS. The SOPs must also point out the areas of subjective decisions by management along with the reasons and implications of such decisions.

- Provide for increased staffing and for effective deployment of this staff to assist managers in the development and use of WS.

Explanation

This guidance would be issued by OSD and would replace existing guidance. It would seek to provide specificity to the nature of WS and their development and to place the development and use of WS as an authentic and meaningful tool for use in overall

performance and resource management by DoD and its Components. The nature of this guidance would be to place WS at the disposal of the managers as additional tools to assist them in managing more effectively rather than imposing another "special program" upon them. Therefore, it must be firm in its structure but flexible in its application.

This guidance will need to take into consideration the government culture in which managers function, along with DoD's move toward competitiveness and customer satisfaction. This will provide DoD managers with realistic expectations and incentives for improving the performance of their "performance units" and using WS as one of several tools to reach this goal. This guidance cannot just say "this is good for you, you should do it". It must emphasize that "given the things you deal with as a manger, here are some things which you might use to help you be more successful as a manager."

In addition the guidance will seek to promote the development of partnerships among all levels of management to achieve improved performance. This would allow the divergent concerns of upper management regarding budgets to be balanced with lower management's concern to "get the work done." It would also enforce feedback loops among the areas of planning, execution, assessment and improvement.

> *(Note: When considering personnel policy change, it should be noted that managers need to be given more authority to re-distribute personnel resources to meet workload changes, to broaden and generalize job classifications, and promote retraining. Without these changes, the managers cannot effectively improve their performance and the value of WS is severely down-graded.)*

Benefits

- This recommendation addresses OFIs 1, 4, 5 and 6 above.

- The guidance would serve as an overarching framework which would provide the necessary structure and support to the ultimate users.

- The guidance will provide clarity for the use of WS and help the manager to understand when to develop them, how to use them, and the consequences of not using them. It would provide a meaningful link between the development and use of WS to overall performance.

- It will comply with the IG and Government Accounting Office (GAO) recommendations that policy and guidance for work measured labor standards be revamped.

- It will provide firm "enforcement" and meaningful "incentives" for the development and use of WS.

Contributing Data

Policy

- Standardize the development, documentation, and use of engineered labor standards

- Define the role of work measurements and instruct managers on the value of using these standards when managing to effectively work within the confines of

the current environment of Defense Business Operations Fund, TQM, and fiscal restraints

- Develop specific requirements for engineering labor standards, evaluating work measure program performance, updating standards, and reporting program data to the OSD .

- Establish system controls for work measurement functions by revising local policy and procedures to include quantitative criteria for developing and updating engineering labor standards and for the limits and frequency of variance analysis. Equal emphasis should be placed on the accuracy of labor standards for both competitive and noncompetitive workloads.

- Develop specific guidance requiring standard operating procedures which address functions covered and regular process of review for monitoring and noting exceptions

- Evaluate the procedures used by both the competition office and the organic work measurement personnel and promote the consistent development and use of labor standards

- Implement standard operating procedures for identifying those labor standards that need to be re-evaluated and updated by the work measurement personnel. The procedures should include the review of performance efficiencies of labor standards

- Establish specific guidance requiring standard operating procedures for developing non-engineered labor standards and for performing variance analysis for organic and competition workloads

- Make routine updates to frequently used labor and material standards. Depots should routinely perform variance analysis in order to maintain the high level of standards accuracy necessary for effective business process improvement

Relationship (Links) to Performance Improvement Efforts (e.g., ER, BPR, GPRA, etc.)

- Tie work standard into mission **performance**

- Relation to GPRA by basing labor efficiency measures on work standard (time)

- Establish plans and qualified goals for engineered labor standards

- Continue Navy Depot (NADEP) process reengineering and Depot Maintenance System (DMS) (Baseline Advanced Industrial Management [BAIM] or Programmed Depot Maintenance Scheduling System [PDMSS], Depot Maintenance Material Information System [DMMIS]/Manufacturing Resource Planner [MRP] II) implementation efforts as rapidly as possible within resource constraints

- Continue process Reengineering Efforts

  - Effective business process improvements will require close coordination between maintenance and supply personnel to ensure that available material inventories efficiently satisfy depot material requirements

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- Improve documentation of productivity improvements - Productivity improvement efforts are reducing the cost of depot operations. However, failure to adequately differentiate between productivity improvements and work content changes makes it difficult for the NADEPs to document how process improvements are offsetting some of the cost increases caused by workload increases.

2.4.2.2 Methods to Work Matrix

Statement

The range of available methods for standards development should be mapped to the types of work situations/functions for which they are applicable.

Explanation

The use of a "taxonomy" of standards would provide a structured approach for developing WS. This would replace the current classifications of engineered (class A) and non-engineered (class C) labor standards, as well as replace "the long study" verses "an educated guess" for staffing standards. It would act as a tool to determine the optimal relationship of method of development to work process in light of usage, time and money requirements. This would provide legitimacy to the variety of techniques and standards being developed and used. In addition, it would provide flexibility in developing and using WS.

Benefits

- This recommendation addresses OFIs 1, 3 and 5 above
- Provides a tool to the manager for selecting a method of standards development based on work process and constraints
- Provides a more consistent and structured approach to standards development and application
- Provides a faster response with reuse of current standards
- Provides the ability to balance the economics of alternative methods

Contributing Data

- Select the information required for developing a "standard"
- Determine which functions require which standard
- Develop an hierarchy of standards
- Develop a new category of non-engineered standards
- Establish a repository of standards
- Apply Statistical Process Control (SPC) to labor standards for better results
- Establish Class B category of non-engineered standards, representing the nominal time required for a trained worker or group working at a normal pace to produce a specific unit of work with acceptable quality
- Define why and how a work standard is built and used

- Evaluate service management/work standard program

- Permit the use of "self measure"

- Review and update existing labor and material standards

- Update and validate existing NADEP labor standards. These standards may be inaccurate because efforts to develop and maintain them have been de-emphasized in recent years.

- Standardize the applications of work measurement techniques used by the Military Departments by establishing a priority within the DoD corporate information management initiatives that allows the completion of a system for sharing computer systems and common databases

- Determine the most cost-effective length of time that a labor standard should cover, then consolidate and reduce the number of existing labor standards for maintenance operations of short duration to conform with the new criteria

- NADEPs are updating current industrial operations standards to ensure they are sufficiently accurate for assessing production performance and implementing improved business practices

- Use NAVAIR developed procedures for reconciling differences between NADEP budget data and the underlying labor and material standards

- Reconcile differences between labor and workload standards. Recommend that NAVAIR develop definitive procedures for reconciling differences that may arise between budgeted workload standards and the underlying NADEP labor standards

- Use NADEP budget documentation address how work content changes and productivity improvements affect industrial operations standards.

- Replace the term "Work Measured Labor Standards"

  - Use "Work Measured Standard" instead, and define the various types/categories of standards, the type and level of work for which they are most economical to develop, and the use and benefits of each

  - Change the paradigm that measured work is only engineered labor standards

  - Expand the concept that all work projections be based on developed standards—only one category of which are engineered labor standards

- Educate government managers regarding Work Measurement Standards (WMS) and Engineering Labor Standards (ELS). Differences were found in the use of labor standards with commercial industries using more flexibility to align ELS. Commercial contractors were perceived to be more concerned with using good ELS-based WMS to reduce costs while defense contractors were perceived to be more concerned with using them to justify costs. In addition, commercial managers were found to be generally more knowledgeable of WMS and ELS than government managers.

2.4.2.3 Automated Support System

Statement

A common automated system should be developed which supports both the development and the use of WS (operational management) and be linked to resource and financial planning and accounting.

Explanation

This system will incorporate automated support for the development of labor and staffing standards which will be tied into the management support system. The management support system would make use of the work standard factor (as one of many other factors) in estimating and planning the workload, in monitoring and managing work performance, and in assessing the on-going work as well as the completed work. This system would also provide data up to and down from the resource management tools at higher levels. As such, it will assist the managers in doing their job, not provide added work. "Common" refers to a configuration that would provide open interface between various component systems, applications and databases. This system would also have to be generic enough to permit application to a great variety of work processes and workloads. The main requirement is that it must be "on-line" (real time) so that exceptions can be noted and dealt with as they occur. The system would need to have work time logged in and out automatically. It is recommended that it also be linked to the pay system. This way time to work accounting would be insured and it would provide an automatic and accurate accounting for the use of personnel funds--by work process.

Without such a system, widespread and common use of WS will not be feasible or practical. Their use will be limited to work functions which have labor standards as part of the normal management system.

With such a system, WS would be necessary for the system to function. Such a system is the only effective way to require and enforce the use of WS.

Benefits

- This recommendation addresses OFIs 2 and 5 above
- Assist managers in doing their normal job of managing easier, faster, and better
- Enforce the link between WS and resource management
- Provide objective, documented basis for manpower analysis and requirements development
- Encourage and support the partnership of work standard developers, lower management and top management
- Provide common (generic) WS that could be shared, applied and reused across DoD
- Provide common, consistent, reliable, and available data for resource management and accounting

- Ensure the use of WS as well as objective accounting for time and personnel resource use since the manager's system would not work without the standards and people would not be paid without the standards

Contributing Data

- Improve communication amongst the components using:
  - Teleconferencing
  - Electronic distribution of information
  - Lessons learned for web site
- Develop and implement a DoD-wide system for sharing technology, innovative developments, common data and tools generated by work measurement efforts that:
  - Establish an electronic network linking all the work measurement activities to enable sharing of information and technology
  - Ensure that databases of common data and tools are accessible by all functional managers through the electronic network
  - Support determination of resources requirements that reflect workload and process changes
- Improve coordination process of all players (speed it up)
- Have time data automated
- Keep paperwork to a minimum
- Develop an automated project management system
- Tie data collection in to management and accounting system (labor accounting must be linked to manpower and/or labor standards)
- Use labor accounting through payroll system (historical utilization)
- Have an automated system for developing and applying WS to track actuals, and produce analysis and reports. (generic enough to accommodate all categories of standards and various breakdowns of work.)
- Implement to its full extent an automated standards setting system for organic and competitive labor standard development
- Implement other systems while waiting for DMMIS/MRP II
- Reduce duplication by adopting the Automated Information System (AIS). Once developed, it will be designed to meet the automation requirements of the DoD Components
- Use automation for monitoring and updating labor standards and for performing variance analysis
- Modify the existing electronic data system to identify standards that need to be updated and to identify significant variances for variance analysis of labor standards with recurring, out-of-tolerance operations

- Study private industry for benchmarks

2.4.2.4 Centralized Support/Service

Statement

The support for the development of WS and for customer service should be combined with improvement support. This support should be located in a central organization. In addition, the representatives of this support group should be assigned to assist the various levels of managers in the use of WS in planning, monitoring and assessing the workload and production. Furthermore, workers should also be included as part of the work standard development team.

Explanation

There should be a centralized pool of IEs, MAs, and other personnel with access to appropriate tools which will provide assistance in developing and using WS. This support pool, while providing improvement programs, tools and training, would also be able to integrate management improvement with WS. The center would provide a repository of work standard development services, skills, training, work standard data and work standard automated system support.

In addition, IEs and MAs from this group would be assigned to the management team at appropriate management level. These persons would assist the manager in developing WS and in the effective use of work standard for planning, monitoring and assessing work performance. Establishing a central pool of IEs and MAs to support managers would ensure the use of WS and help educate managers on the value of using WS. Additional advantages of the central pool of personnel include:

- Diminishing the perception that these MAs and IEs are "outsiders" who are not there to help managers by locating them "on-site"

- Ensuring consistent feed back to upper management as they would report to the manager at the central location and not to the local manager. This would prevent the "on-site" person from being "co-opted" by the local management and circumventing the effective use of WS by the local management.

- Assisting in "marketing" WS

The danger to be guarded against is that of the "on-site" person being "co-opted" by the local management to circumvent effective use of WS by the local management.

It is critical to get worker input when analyzing the work process, to capture suggested improvements and assist in developing realistic WS. Since workers are the ones to track actual production results, they comprise a critical element in the measuring, setting, and implementing WS.

Benefits

- This recommendation addresses OFIs 3 and 4 above

- Provides centralized, and effective use of limited resources

- Provides commonality of methods, work standard data, systems and implementation across a DoD component if not across DoD

- Provides effective links with local manager and workers

- Helps managers use WS for effective monitoring and analysis instead of spending time mandating the use of them by managers

- Provides a practical and effective (not theoretical) link between WS and process improvement

- Provides and maintain a common automated support system for development and use of WS

Contributing Data

- Have skilled, trained people

- Involve workers in developing Labor Standards and doing variance analysis

- Determine and assign the appropriate personnel staffing to accomplish an effective work measurement program for engineering and updating labor standards in the organic and competition work measurement programs

- Assign more staff to standards development

  - Management Analyst

  - Industrial Engineer

- Staff the Work Measurement Business Process Office with sufficient personnel to effectively oversee the implementation of Military Departments' automation of work measurement programs

- Centralize resource assets at installation or other locations

2.4.2.5 Incentives/Accountability

Statement

A system which combines positive incentives and firm accountability should be established to encourage and reward those who improve performance, reduce costs, and do more with less.

Explanation

This recommendation seeks to address the weak concern for improving performance within the government where justification vs. control, budget vs. profit, and concerns about the promotion system take precedence. Adequate implementation of this recommendation requires adjusting the business approach to make the concern with performance improvement and meeting customer needs a priority. Failure to address the business culture is a major reason why BPR improvements are often not successful. Once a cultural change is identified as necessary, while it is rather easy to describe the cultural change which is necessary, it is very difficult to identify practical steps by which to implement the change.

The implementation of this recommendation would seek to tie a manager's position, security/advancement to objective performance achievements and improvements and/or the use of effective management practices. It would also require resource requests and accountability to be based upon objective documentation of the relationship of workload

and personnel. This would involve regular oversight/review, quick and firm accountability and enforcement. Coupled with this will be the need for positive, financial rewards for improvement of performance and/or savings generated.

Another aspect would be the institution of team management which combines upper and lower management's responsibility for the success or failure of a given workload.

Mandatory training courses in performance management will need to be developed and implemented for all managers.

Empowering the "customer" of DoD services to reject DoD products/services and/or shop around would also address this recommendation. It would also include promoting "fee for service," and privatization—to provide a climate of competition

The implementation of this recommendation is likely outside the scope of this Project, but such recommendations need to come from this Project to the proper authorities. Also, influence and power must to sought and leveraged by this Project on behalf of implementing practical solutions along the lines of this recommendation.

Benefits

- This recommendation addresses OFIs 1, 3, 4 and 5 above
- Managers desiring ('pulling') WS rather than resisting the use of standards being 'push' on them

Contributing Data

- *Incentives*
  - Reward process or control improvement
  - Provide incentive and multiple utility of data (multiple credit)
  - Link work standard measurement to various awards
  - Invest savings into PECI
  - Packaged into one program
  - Allow flux/shift resources
- *Accountability/Oversight*
  - Enforce process for review (monitoring, mechanism when changes occur). Get rid of oversight above/unnecessary workload.
  - Enforce Use of Standards - Until a person's job/advancement is on the line for performance in which cost and time are a key factor, Work Standard will not be widely used —or until it is required and enforced that contracts and/or budgets are to be based on Work Standard.
  - OSD should assume an active role in guiding the application of work measurement and its use in DoD.
  - Provide adequate oversight and inspections to ensure instructions are properly enforced by the Depots, including validation of adequacy and implementation of the depots' policies and procedures.

2.4.2.6 Marketing/Customer Service

Statement

The WS development community should develop a pro-active "marketing" effort to inform their "customers" of the value in using WS. Part of this effort would include assisting the managers in determining the most useful (value-added, uncomplicated, etc.) WS to use and using them to plan and make performance assessments, etc. Allow the managers to "ask for" the WS they need rather than "pushing" WS on them.

Explanation

Since there is much misperception about WS and their use and since managers (customers of work standard development) do not seem inclined to use them, a serious marketing effort is needed to inform the customer of the values and benefits of using WS. Also, the developers of WS would seek to improve their ability to satisfy their customers— becoming customer service oriented. IEs and MAs would also function in a partnership style rather than an adversarial style. It would mean being more flexible and service oriented rather than insisting on certain techniques/standards, a precise level of accuracy and a certain level of sophistication.

Benefits

- This recommendation addresses OFI 3 above
- Provides a positive perception that WS are a helpful tool for managers
- Increases demand for, and use of, WS

Contributing Data

- Meet with customer before setting standard
  - Look at variance analysis and process improvement
  - Introduce manager with standards development experience
- Increase customer satisfaction
- Incorporate customer service (standard executive order)

2.4.2.7 Management Culture (Guidance, Incentives and Accountability)

The existing management culture in DoD was identified as the major block to effective use of labor standards. This culture does not reward improvement of performance and better management if such improvement results in lower funding (reduction in budget) or reduced manpower requirements. Nor does this culture provide firm, pro-active oversight and accountability (enforcement) of policy and guidance. Another road block to improvement is the difficulty of increasing, decreasing or replacing personnel even when the data reveals the need for it. Therefore, a manager cannot take advantage of identified performance improvement opportunities. Also, it is clear that performance improvement programs "pushed" on managers are not welcomed. Furthermore, good management cannot be produced by policy, guidance and regulations—"a horse can be taken to water, but cannot be made to drink."

Therefore, creative thinking needs to be done as to how to implement culture change given the limited use of policy and other guidance. Innovative systems of rewards need to be devised. Meaningful and firm structures of oversight and accountability need to be designed. In addition, a new approach by OSD and a new role for policy in encouraging good management needs to be developed. This approach needs to be tempered with respect the realities of the current culture and the limitations for making changes.

2.4.2.8 Staffing Standards and Regulation Changes

For meaningful development and updating of staffing standards, reliable historic data is required. This can be obtained only by tracking personnel daily hours against work tasks for which staffing standards have been or are being developed. For these to be realistic and meaningful, they need to be tied to the payroll account. Since staffing standards relate more to "indirect" labor, this involves major changes in the way personnel time is recorded and accounted for. The possibility and feasibility of such a change needs to be investigated.

Without such accounting (tracking) for actual usage, staffing standards and manpower requirements are, at best, an educated guess. Realistic implementation of this would begin with work processes which have the highest priority for value-added pay-back from the use of such accounting and tracking. This would be implemented in conjunction with developing the automated system for managing such accounting, which also would be incremental in its deployment. Thus, rather than a massive change in accounting policy and regulations, there would only need to be some type of permission to pursue this type of accounting.

3. IMPROVED DESIGN

3.1 Context

3.1.1 Introduction

Building upon the Baseline analysis and "case for change" of the current WS situation (Section 2), the next step develops a proposed improvement or redesign for WM/LS. This Section presents and documents the proposed redesigned (To-Be) concept of the work measurement discipline—the word "discipline" will be used instead of "functional process," "business area," or "program" to refer to this subject area since none of these terms are completely applicable to work measurement..

This Section provides a CONTEXT for the work of improving the work measurement discipline. Section 3.2 APPROACH and METHODS describes *how* the new concept was developed. Section 3.3 THE REDESIGNED CONCEPT then describes *what is* the new concept for this discipline. Section 3.4 POTENTIAL IMPLICATIONS presents some of the possible *implications* of this new concept. Lastly, Section 3.5 CASE FOR CHANGE AUDIT TRAIL relates the new concept to the problems and recommendations for improvement ("case for change") that were presented in the Baseline Analysis, Section 2.

3.1.2 Scope and Viewpoint of the Redesign

The original scope of DPPI Phase II was the traditional DoD program of work measurement and labor standards and its main area of application—maintenance and logistic depots.

Investigation into the current (As-Is) situation revealed the Work Measurement discipline was in the process of transitioning from its traditional understanding and role toward a broader, more complex and integrated understanding and role. This was due in part to its response to the general shift in DoD from a limited concern for productivity to a broader concern for performance. The lack of demonstrative efficiency and effectiveness (added value) from the development and use of highly refined engineered standards provided an additional motivation for change, along with several other factors noted in Section 2.

Part of this transition involved expanding the understanding of "work measurement" from just "measuring the time it takes to do a unit of work" to "measuring work input." ("Work input" is what is needed by a unit of work to produce the products or services required of that unit of work. It should be noted that this is different from "measuring work output" which is measuring the products or services actually produced by a unit of work.) Thus, in addition to labor standards (the time factor), staffing standards (the manpower factor) were identified as major aspects of work input. However, both of these factors state a relationship of *work*, *time* and *manpower*. For one, *time* is the main variable. For the other, *manpower* is the main variable. Both of these factors are the result of intensive and extensive analysis and measurement of units of *work*. (The redefining and renaming of the terms *labor standard* and *staffing standard* are part of the redesigned concept and will be presented in Section 3.3 below. For now, the more general terms *time factor and manpower factor* will be used.)

While material, equipment, and facilities are other factors of input they were not included in the scope of this Project. Their role in performance and their influence upon time and manpower factors was noted. However these factors are special areas of management, and the subject of specialized, major improvement efforts and therefore are not subjects of the on-going management of work. As such, the development of these other factors are considered aspects of disciplines other than "work measurement." And while there may be "standards" or specifications associated with material, equipment and facilities, these standards are set by industry, manufactures, DoD, or other governmental bodies.

Another aspect of the transition of this discipline is the recognition of the role of management in this discipline. Management provides the requirements that initiate the development of time or manpower factors. It is these management requirements which also determine the nature and extent to which time and manpower factors will be developed. Without the effective use of time or manpower factors by management (in estimating, planning work execution, controlling production of products and service, assessing results, and enhancing performance) the development of these factors falls into disrepair and they become unreliable. Also management is increasingly being seen as a partner in the development of time and manpower factors as well as the owner of these factors. In return, the developers of these factors are increasingly being seen as assisting management in the use of these factors in the management processes.

Therefore, as a result of the addition of the staffing factor and of the increased role of management, the understanding of the scope of "work measurement" has been expanded. The expanded scope of the work measurement discipline includes the development, application and maintenance of time and manpower factors and providing assistance to management in their use.

The traditional developers of time and manpower factors have been IEs and Management Analysts/Engineers (MAs/MEs) respectively. As shown below, the understanding and execution of their role are also in transition. As the primary players in this discipline, the redesign of the work measurement discipline is primarily considered from the IE/ME viewpoint. Because management is the "customer" of time and manpower factors, their viewpoint and their need for and use of time and manpower factors are taken into account in improving the work measurement discipline.

3.1.3 Relationship of the "As-Is" To "To-Be"

The model of the As-Is processes for the work measurement discipline (DPPI Phase II) was recognized in the Section 2 as being too narrow. This model focused only on the development of traditional labor and staffing standards. It was determined that the model needed also to show the use of labor and staffing standards and include an explanation of management's needs/requirements for such standards. Therefore, the research and investigation into sources and examples of improvement included a more extensive investigation into the current development and use of labor and staffing standards.

This research and investigation indicated that the work measurement discipline is quickly transitioning from its traditional mode of operation to a very different mode of operation. This new mode is not only an improvement, but it is a basic change in the understanding and operation of this discipline.

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As a result, the To-Be description and model of the work measurement discipline does not describe an incremental change and improvement of the As-Is processes. Rather, the To-Be description and model portray a basic redesign of the understanding and functioning of this discipline. The To-Be presents a new concept of the work measurement discipline.

3.1.4 Relationship of DPPI Phase I Redesign To Phase II Redesign

DPPI Phase I documented the redesign of the traditional DoD Productivity Program into the Defense Performance Management. The WM/LS program was a specific aspect of the DoD Productivity Program. The redesign of the work measurement discipline (DPPI Phase II) is undertaken as a specific aspect of the comprehensive redesigned world of performance management (DPPI Phase I). This report will document the relationship of the redesigned work measurement discipline (DPPI Phase II To-Be) to the previously redesigned performance management (DPPI Phase I To-Be) initiative.

Because the word "measurement" is used in reference to both "work" ("work measurement") and "performance" ("performance measurement"), the distinction between these two uses needs to be noted. "Work measurement" is the measurement of *work input*—primarily required time and required manpower --for **projecting** future input needs. "Performance measurement", on the other hand, measures the **actual** results of all aspects of performance (input, work processes, output and outcome). Thus the primary focus of "performance measurement" is the measurement of actual *work results*. Thus, conceptually, DPPI Phase II is about measuring projected work input (and its role) while of DPPI Phase I was about measuring work results (and its roles).

3.2 Approach and Methods

3.2.1 Introduction

This Section describes how the redesigned concept of the work measurement discipline was initiated and developed. It also documents the approaches and the methods employed in designing the proposed To-Be work measurement discipline. The basic approach was to:

- Research leading-edge books and articles dealing with this discipline
- Investigate exemplary programs of time and staffing standard development and use
- Involve functional practitioners of work measurement in redesigning the work measurement discipline (primarily in a workshop setting)

Section 3.2 includes details on the sources, general observations and key findings of each approach. The detailed reporting of the results of these approaches—the redesigned concept—is discussed in Section 3.3.

Section 2 recommended further investigation to assess the existing work measurement activities, techniques and tools and to determine how labor and staffing standards are being used. In this way, the Baseline understanding could be validated and enhanced. Therefore, during the research, interviews and workshop, attention was paid to the current

execution of the work measurement discipline and issues of concern as well as to suggestions and possibilities for improvement.

Investigation of work measurement practices in both the private and government sectors was performed to identify exemplary approaches, techniques, and tools in the development and use of time and manpower factors for use in improving the DoD work measurement discipline. Interviews were conducted with the developers and users of both time and manpower factors for the Army, Navy, Air Force, Defense Logistics Activity (DLA) and private sector companies. The analysis of time factors required visits and interviews with maintenance/repair/logistic depots, shipyards and private companies. The analysis of manpower factors, on the other hand, required visits and interviews with "manpower" analysis activities of the Army, Navy, and Air Force. However, no private company was identified for inclusion in the review of manpower factors.

Representatives from these visits/interviews were then invited to attend a week long workshop to refine these findings and develop a new design for the work measurement discipline.

3.2.2 Research

Research involved reading and review of books, documents, and articles relative to work measurement disciplines. The sources and the nature of their contribution are listed below.

3.2.2.1 Motion and Time Study, 7th Ed. by Marvin E. Mundel and David L. Danner.

The understanding of motion and time study and work measurement as presented in this book forms the basis for the redesign of the work measurement discipline.

"*Motion study* consists of a wide variety of procedures for the description, systematic analysis, and improvement of work methods...", p. 1. *"Time study* consists of a wide variety of procedures for determining the amount of time required, under certain standard conditions of work, for tasks involving some human, machine, or combined activity.", p. 2. It goes on to note that the two areas can be used in determining each other and therefore cannot be neatly separated into two different studies.

It is important to note that "motion and time study techniques are neither the managerial process nor a substitute for it, but are a series of techniques that may be usefully employed to assist in the performance of many of the steps in the managerial process.", p. 6.

Work measurement is a generic term referring to the use of any systematic technique for developing numerical coefficients for converting a quantitative statement of workload to a quantitative statement of the required time use of resources such as machines, human endeavors or robots.", p. 52-53. The 'bottom line' of this statement is *numerical coefficient.* The related critical terms are *any systematic technique,* and *quantitative statement of workload.*

Mundel and Danner's book provides a basic formula for standard time that may be used at any of the eight (8) orders of work-unit—which range from a "motion" (1st-order) to "results" (8th-order) or what is achieved because of the outputs of the activity—p.103. *Standard time* equals *work time* divided by *work count* (output from work unit during the

work time) multiplied by a real world rating *modifier* plus any *additives* to adjust the time to real people (see pages 63 and 73). Standard time may be a complex calculation or it may simply be the actual work time or the work time set by the description of the job. It is always a time factor. (Given a quantitative statement of workload, the standard time numerical coefficient can be used to translate the workload into man-hours required to do the work. But this is an extension of Mundel and Danner to manpower analysis and requirements.)

The main content of the book explains and illustrates various techniques of motion study and time study and then discusses their application.

3.2.2.2 "Work Measurement: A Series of 3," *Industrial Engineering*, Vol. 27, No.4, April 1995.

The first article provides an example of, and case for, low-tech work measurement (and low cost) tools as a means of gathering the necessary data for measuring and improving work processes.

The second article notes that every manager uses some time number (factor, standard) each time he/she estimates a cost, produces a work schedule, provides a completion/delivery time, states how much work can be accomplished in a given period of time, or makes any number of other managerial decisions. The only issue is, how realistic is the time figure they used. As the accuracy of the time figure increases, the accuracy of a manager's predictions increases, the waste of valuable resources decreases, and fewer are the failures to produce expected results. The article describes several basic methods of determining more realistic time figures and noting the type of work for which they are most applicable. In summary, "since practically everyone is already using standard times in one form or another (even if they are an educated guess), using work measurement to develop these times is simply an improvement on what you are already doing. Computerization not only speeds the development, but fosters maintenance of standards.", p. 24.

The third article focuses on achieving planned performance results and using measurements as one tool to help managers achieve their planned goals (and to know that their plans are fulfilled). This only works if managers have a plan and are concerned about fulfilling that plan. The article discusses both input measurement and output measurement. The operative word is "control" and "measurement is a means for controlling the production of results. In summary, "operations measurements are an important aspect of management control in manufacturing plants (and other areas that focus on producing results). Measurements establish baselines and trends. They also point out problem situations that must be addressed and resolved. The process of measurement provides information for decision making ....", p. 29.

3.2.2.3 Defense Work Methods and Standards, Vol. II, of Defense Management Joint Course.

This is a course book used by the United States Army Management Engineering College. This book introduces work measurement, defines the various terms and components in measuring work, distinguishes the types of labor standards, and explains various methods of determining labor standards.

3.2.2.4 Various Manuals from the Air Force, Navy, and Army

These manuals set forth their processes and methods for determining staffing standards and requirements. All the Services focus on the Work Center as the level for which staffing standards/requirements are determined. All the Services use a variety of techniques depending upon the nature of the work conducted within a Work Center. The Army uses a 12-step process. The Air Force relates staffing determination to process improvement efforts. The Navy uses systematic manpower analysis procedures for developing staffing requirements. Definitions of "staffing standard," "staffing requirement," "staffing need" vary, however the bottom line is the conversion of a particular workload (or assigned mission responsibility) into man-hours or full-time-equivalents necessary to accomplish the work. This staffing factor/number is used to as base line factor for determining manpower requirements, determining manpower to be requested, allotting and distributing manpower, assessing the use of manpower, etc. Sometimes these standards/requirements address only military manpower, other times they address both military and civilian (in-house), and sometimes (rarely) they include all manpower regardless of classification.

3.2.3 Interviews

In order to learn from exemplary work measurement programs as well as to expand the understanding of current work measurement efforts within DoD, several sites were identified for interviews. The intent was to select representative sites from the DLA, the Army, the Navy, the Air Force and the private sector for both labor standards and staffing standards. Where feasible, sites were visited and interviews were conducted in person. Otherwise, interviews were conducted via conference calls to permit group participation.

3.2.3.1 DLA

Location visited: Defense Depot, Richmond, VA

People interviewed:

- Sally Vingi—DDRV/Resource Management/Budgeting
- Perry Bracket—DDRV/Packing Supervisor
- Mr. Miller—DDRV/Manager: Receiving Division
- Walter Calvin—DLA/Office of Process and Resource Analysis
- Carl Gully—DLA/Office of Process and Resource Analysis

Labor standards are developed for 50 basic processes with detail breakdown of work-flow steps and related documentation and times. These are developed using predetermined time standards. Each standard is then applied (and adapted as necessary) to each depot. The standard time is used in accounting, budgeting and evaluations (earned time vs actual time) with data being tracked by their automated payroll. The challenge is to account time to labor codes with accuracy. Labor standards were also used in workload management (estimating, scheduling, staffing, regular assessment and adjustment) to "get the product out the door." There is a need to check with the managers in developing automated systems to be sure it provides what they need to manage. Also there is a need

to use work units that are machine countable so that there are automated counts of time to work units.

DLA Process and Resource Analysis office functions with both centralized staff and on-site staff. The labor standards "shop" is moving to the "fee for service" and "consulting" mode.

3.2.3.2 Naval Aviation Depot and Naval Aviation Repository

Location visited: Naval Aviation Depot, Cherry Point, NC

People interviewed:

- George Thomas—Naval Aviation Production Division, Production Engineering
- Tim Burgress—Naval Aviation Production Division, Production Engineering
- Ray Miller—Naval Aviation Depot, Budgeting and Manpower
- Jim Hall—Naval Aviation Repository
- Dave Hodres—Naval Aviation Repository
- Denny Hellman—Naval Aviation Repository

Labor standards are an integral part of the "work instructions" for planning, scheduling and controlling maintenance and repair tasks. They are also used in estimating, costing, budgeting and billing of expenses. Navy uses a "class B" labor standard that requires documentation but not statistical reliability of a "class A" labor standard so that they can provide a value added standard at a reasonable price. Since they are not able to cover all areas of work with "class B" standards (update and maintain existing standards) they are prioritizing work areas for which it is most beneficial to use standards--and thus demonstrating to management the value of using labor standards.

The Repository is a centralized function of providing automation, data and service (training and facilitation of analysis and improvements) support to Navy depots. The main resource that is provided by the Repository is the Resource Planner—an expert system for assisting industrial engineers in developing (customizing/tailoring) labor standards. There are also "expert modules" of pre-described packages of work and times. It also permits linkage to the Master Data Record that is a labor standard for a line in a labor document of an operation.

3.2.3.3 Navy Manpower Analysis Center

Location visited: NAVMAC, Millington, TN

People interviewed:

- John Moss—Head, Shore Requirements and TFMMS Management Department
- CDR Jerry Ellison—Head, Aviation Manpower Requirements Department
- CDR William Jacobs—Head Ship Manpower Requirements Department
- LCDR Guy Cunningham—Head Aviation Standards Review/Development Div.
- Ken Ingerson—Head, Shore Requirements Analysis Division
- Kathy Kuntz—Head, Shore Program Management Branch

The vision of this Center is to "become the exclusive provider of timely, credible, impartial manpower information for the DoD." NAVMAC as an agent for Deputy Chief of Naval Operations (Manpower and Personnel)(N1) and the director Total Force Programming/Manpower(n12): develops wartime (Ship and Squadron) manpower requirements, develops policy and conducts oversight analysis of shore manpower requirement, and reviews and documents wartime and shore manpower requirements in the Total Force Manpower Management System (TFMMS). NAVMAC provides consulting services in manpower management, performs manpower analysis and develops related manpower analysis tools and models.

Determination of manpower requirements for Navy activities is focused on the identification of required operational capability and projected operating environment (wartime) or mission, function, task (shore) and associated workloads. The future of Navy requirements determination is to develop fundamental information required to derive unit costs for products and services—outputs. This must be accomplished through identification and standardization of core business areas, and their associated outputs. As unit costs become available, these outputs can be tied to higher level workload factors (e.g., squadrons) to support resource allocation decisions.

3.2.3.4 Navy Shipyard

Location visited: Norfolk Navy Shipyard, Portsmouth, VA

People interviewed:

- Nick D'Amato—Asst. Chief Engineer
- Brian Thomas --Industrial Engineering, Labor Standards Section
- Todd Fairchild—Industrial Engineering, Labor Standards Section
- Mike Williams—Operations/Program Analyst
- standardize Baker—Planning and Estimation

Major cooperative efforts are underway among shipyards (Navy and commercial) to standardize terminology, procedures and benchmarks for work tasks, common skills, direct support and labor standards. They have developed benchmarks for support (non-direct) labor categories as a percentage (ratio) of support service to "wrench turning." These are used like labor standards in estimating, scheduling and controlling (track and assess progress of work) workloads. The pressure is on all of them to improve and cut costs in a downsizing environment.

They work with "packaged jobs" in which all "shops" share in getting the job done rather than just "their shop's work." There is also strong partnership and team work between management and workers, between the planning/estimating team and the production team as the "project team." The "paper" of all planning has been consolidated and standardized. The challenge is to reduce support (service) costs. They BAIM for estimating, tracking and assessing work--real time.

They develop both Engineered Methods and Standards as well as Estimated Standards. All labor standards are fully documented. Standards are constantly being evaluated and updated. Labor standards are used by the estimators in preparing projections and

execution documents (Task Group Instructions). Work is assessed according to the execution documents. "Trouble Desk" handles all problems that are preventing execution according to the execution document. Industrial engineers are part of the planning, estimating, and the "trouble desk" (for analyzing, evaluating and resolving production problems).

There is a Performance Measurement Control group that watches to see if labor standards are too high or too low.

3.2.3.5 Army Material Command Manpower Engineering Activity

Location Visited: AMCMEA - Industrial Operation Division, Letterkenny Army Depot, Chambersburg, PA

People interviewed:

- Dewey Hustler—Chief, Industrial Operation Division

One model for developing manpower standards is to determine the mission workload and supporting functions, then determine the manpower needed to do the workload. This manpower number then becomes the baseline from which to determine changes and improvements in the need and use of manpower.

They are under directions from the Under Secretary of Army for Readiness and the AMC commanding general to provide realistic documentation for manpower requests. In fulfilling this requirement, they are doing analysis of each Work Center (functional areas) at all AMC installations. For each work center, work time, workload and manpower needed are estimated (using technical estimate types of measurement techniques). The critical aspect is linking workload to manpower. It is critical to link workload and manpower so that when one is changed the impact upon the other is noted also.

AMCMEA does not use traditional staffing standards but rather uses "staffing equations"

Work measurement people need to be (and in AMCMEA they are) "performance analysts" to determine both labor standards and manpower needs and to provide process improvement and economic analysis services. Such personnel are really "production controllers" by workload schedules rather than by standards. They are partners with management in being "problem solvers." (This would mean that work measurement people need to be associated with the planners and production people rather than the comptroller/resource management people—manage performance rather than dollars.)

There is a need for a reporting system to get data and establish a baseline for "white collar productivity measurement." One way would be to link work-time to the system tracking time for people's pay check.

There is a role for a "central consulting group" and for a "local performance management analyst."

3.2.3.6 US Army Force Integration Support Activity

Phone Interview

People interviewed:

- Chris Leeds—Manpower Survey Program

Manpower requirements are man-years required to perform given level of work. Traditional staffing standards are determined by Work Centers and Work Center (Task) Codes. These cover about 40% of Army positions and are getting old at this point of time. There is too much "guessing" these days. Manpower requirements often set by local commander and there is no audit/challenge to this determination. This may be changing with reduction of budgets and forces.

The 12 step method is used only on a small portion of the population. While it insures that they are doing the work required by their mission, it does determine if the work is being done efficiently or effectively—that is, there is no effort to improve the processes.

Too many account codes used for the same work so that there is no way to group like costs or to compare labor time/costs. Work center task codes would be a way to identify and account for common work.

3.2.3.7 Army Depot and Arsenal

Phone Interview: Anniston Army Depot

People interviewed:

- Sara Whatley

This was a brief exploratory conversation. It was determined that Army depots have a weak labor standards program that is currently being evaluated for improvement. They do have historic labor standards loaded, but they are not maintained. They are used only for work that historically has been done at the depot. Since most work is new, the historical standards do not apply. Where some time figure is needed for estimating, etc., they develop such a figure from historical data and past experience.

Phone Interview: Rock Island, Army Arsenal

People interviewed:

- Debora Roesger—Chief of Force Management

The Rock Island Arsenal develops and uses labor standards for all their work. They are developed at the 5th order of work unit. There is a task force of industrial engineers in each Work Center who sets the labor standards for the manufacturing tasks. The main use of the labor standards is by managers in controlling productivity.

For indirect labor they use technical estimates or statistical estimates at the 5th order of work. These are set against a job/part control number and tracked in an automated system related to time/attendance/pay, along with labor standards.

They do not have an automated system for developing labor standards, but are considering the Navy's Resource Planner. They are also considering going with the Navy's "class B" concept of developing standards.

3.2.3.8 Air Force Manpower Engineering Agency (AFMEA):

(Comment: AFMEA will become the Air Force Center for Quality and Management Innovation (AFCQMI) effective 19 December 1996. The "Innovation Center" will represent a consolidation of the current AFMEA and Air Force Quality Institute missions. The combined organization will be at Randolph AFB.)

Phone Interview: AFMEA, Randolph AFB, San Antonio, TX

People interviewed: (These are titles as of 19 December 96)

- Lt. Col. Rudy Bruback— Chief, Operations, Logistics, and Readiness Division
- Maj. Rob Gordon—Chief, Plans and Concepts Branch, Outsourcing and Privatization Division
- Lt. Col. Casdorph—Chief, Outsourcing and Privatization Division
- Mr. Bob Milliman— Chief, Support Branch, Installation and Support Division
- Maj. Cary Glade—Chief, Installation Branch, Installation and Support Division

It was emphasized that their main purpose was not developing personnel standards or measure requirements. Rather they do process improvement; then based on this, with the process "owners," they develop staffing determinations. The purpose is to improve and manage the work with given (or reduced) resources. Traditional staffing standards were considered too expensive to develop and not responsive to customer needs They work with the customer to help analyze, describe, and improve the work processes and functions of a Work Center and the time spent doing the tasks. Time and personnel are only two of the many factors involved in improving work processes.

For the Air Force, Manpower and Quality are being combined into a single agency. The Air Force senior leadership wants "quantum leaps," not incremental changes, in people's thinking and approaches to improvements in doing business.

AFMEA works closely with leaders at all organizational levels to improve operations.

The Function (Air Force Office of Primary Responsibility [OPR]) "owns" the manpower standards/factors associated with the Work Center task descriptions. AFMEA develops staffing factors that are programmable to change when other, related factors change—like workload or processes or resources. A manpower standard/factor is identified by a function name and function account code. (The number reflects the level of work breakdown.)

This approach is resulting in more cooperation with managers (rather than adversarial relationships as in the past). Managers are becoming more concerned with quality and improvement (because of customer concerns and of reduced resources). AFMEA is providing management consulting capability rather than a single product line - "manpower" requirements determination.

AFMEA's approach is very holistic and focuses on quantifying all resource costs consumed by a process (ABC approach). The objective is to help the functional manager maintain or increase mission effectiveness within current or reduced total resources availability. Time and personnel are only two of many factors to be considered. The

emphasis is upon what is appropriate—both for the level of management and for cost/benefit. The focus is on helping Commanders improve processes while using "metrics" rather than the "experts" using "quantification/statistical tools" that are too costly and too detailed to be of value.

It seems the Air Force has a particular management style. It seems as if they get together and see what needs to happen and how it may be made to happen best rather than going strictly by the numbers—a problem solving approach rather than blind obedience to the regulations.

3.2.3.9 Commander-In-Chief Atlantic Fleet (CINCLANTFLT)

Location visited: Shore Installation, Shore Activities Readiness, Norfolk, VA

People interviewed:

- Emily Balke—Data Engineer, in charge of Shore Installation Required Operational Capability (SIROC) Metrics Program
- Terresa Anderson
- Carrole Goudy—GPRA for All Fleet representative
- Merril Dorman—contractor

Objectives of the program are:

- Assessments of shore installations readiness and operational effectiveness on the basis of firm statistical data.
- Identification of resource, manpower, training, facility or equipment deficiencies on a factual and consistent basis.
- Statistical justification for Shore Atlantic Command (SHORLANT) resource allocations.
- Promotion of bench-marking and continuous improvement throughout CINCLANTFLT

This is accomplished by defining the functional structures of shore installations and, for each structure, developing performance metrics for measuring readiness. These metrics consist of:

- Description of the performance metric (what is being measured)
- Definitions
- Report criteria
- Formula/data reported (how the metric is being measured/unit of measure)
- Standards (the set values of the reported data that indicate each level of readiness [M1, M2, M3, M4])

These metric are developed by a Metrics Action Group for each function area by sub-functions.

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The values are reported monthly and are rolled up to indicate the readiness level of sub-functions, functions, installations and over all (with color charts). There are quarterly and yearly composites, roll-ups and analysis. The results, in striking color, clearly indicate who is ready and who is not, as well as trends.

3.2.3.10 Lockheed Martin

Phone interview: Lockheed Martin Electronics and Missiles, Orlando, FL

People interviewed:

- Ron Coonrad
- Mike Ellenwood
- Avenell Boros
- Diana Blake
- Windell Patrick

Labor standards are developed to prepare estimates (time and money); prepare bids; prepare work schedules and instructions (required by work instructions); determine capacity of tools, equipment, machines and floor space; determine product cost; assess operator and department performance; performance control; and determine percent of work completed. The detail and precision of standards depends upon availability of personnel, time, and money and the precision of the planning. Bid estimates always get detailed labor standards because their jobs/profit depend upon a precise estimate.

Operations are monitored (by computer applications and IEs) daily against execution plans (work instructions) to see that production is on schedule. If a discrepancy appears, the IEs will do an analysis to determine the problem/cause and correct it. Data must be daily (real time) of be of any value.

Automated system is tied to work instructions and labor accounting.

Labor standard is tied to part number, work step, department, Work Center, and machine.

Workers have bar-code readers to "wand" in attendance, start-stop of a procedure, completion information.

3.2.3.11 National Aeronautics and Space Administration (NASA)

Phone interview: NASA, Kennedy Space Center, Cape Canaveral, FL

People interviewed:

- Jane Ann Sleeman—Director of Continuous Improvement
- Tim Barth—Chief, Industrial Engineer Group, Shuttle Process

NASA does not use labor standards. Their work is done as few as 7 times a year—not highly repetitive.

They are in the process of developing an expert system for setting "job standards." This describes the work to be done, the time it takes, the skills it takes, and the kind and number of people it takes. This system will also help them determine the level of detail

appropriate for setting these "job standards." (Being developed by a contractor with government money, therefore it will be a system available to any government agency.)

The focus at NASA is on continuous improvement. They use experience and historical data to determine the best time (and other data factors to determine success) and use this in planning, tracking, and determining success. This figure presents the baseline against which improvement in measured.

The IEs consult with management to do analysis of work methods and processes, developing performance metrics for improvement, develop simulations, and do risk assessment/feasibility analysis. They are getting more involved in improving work, not just doing isolated technical specifications in abstraction.

3.2.4 Redesign Workshop

3.2.4.1 Purpose

The aforementioned research and interviews yielded extensive information on effective approaches, innovations, challenges, and potential improvements for the future of the work measurement discipline. However, this information still needed to be compiled into an improved (redesigned) way of performing the work measurement "business." The appropriate people to perform the compilation were the functional practitioners of the work measurement discipline. Therefore representatives of the DoD programs that had been contacted during the interviews were invited to attend a week-long workshop to design an improved work measurement discipline for the DoD. The synergistic interaction among such individuals would not only enrich the nature and content of possible improvements, but also could achieve a consensus regarding improvements to be made and ways to proceed with their implementation. Furthermore, since this improved design will be used as a basis for a new DoD policy for the work measurement discipline, the workshop attendee input (from a field point-of-view) would be helpful for aiding in drafting the new policy.

It was conceived that these functional practitioners who were invited to this workshop would constitute an on-going "working group." The purpose of the working group would be to continue providing practical, field-based input for the products of this Project as well as to participate in the on-going evaluation and refinement of Project products.

In addition, this workshop would be an opportunity to involve other organizations that would have some oversight of, be involved in, or be impacted by changes in the work measurement discipline. Therefore, representatives of these organizations were invited to attend portions of the workshop that would provide an opportunity for them to be updated on the Project's status as well as for them to provide observations and input relative to the improvement of the work measurement discipline. These representatives were viewed as "advisees" to this effort of improving work measurement in DoD. To the degree that such organizations consider themselves "stakeholders" in the redesigned work measurement discipline, they too will be invited to participate in this improvement effort.

The workshop was held September 16-20, 1996, at the Lockheed Martin Defense Enterprise Integration Service (DEIS) facilities in Falls Church, VA.

3.2.5 Participants

Workshop invitees/participants who comprised the "working group" are as follows:

- Air Force   Trixie Brewer   AFMC
                 Glen Coulson   AFMEA
- Army   John Anderson   AMAA
                 Hal Stevens   AMAA
                 Dewey Hutsler   AMC
- DLA   Walter Calvin
- Navy   Kathy Kuntz   NAVMAC
                 George Thomas   NADEP
                 Dave Hordos   NADEP

Other (OSD/Joint Services (JS)) workshop participants are as follows

- P&R   Nina Richman-Loo
- C   Martha Williams
- A&T   Hollis Hunter
                 Donna White
- IG   John Gannon
                 Tilghman Schraden
- J-1   Paul Lovgren

3.2.6 Agenda and Procedures

The agenda for the workshop was as follows:

Monday, September 16 (Afternoon):

    Welcome and Introductions

    Presentation and Discussion of Phase I Results

    Presentation and Discussion of Phase II Status and "To-Be Strawman"

Tuesday, September 17

    Discussion and Validation of As-Is Model

    Update Opportunities for Improvement and Recommendations

    To-Be Modeling

Wednesday, September 18

    To-Be/Redesign of WM/LS

Thursday, September 19

To-Be/Redesign: Major Changes

To-Be Support - Training

To-Be Support - Policy

To-Be Support - Systems

To-Be Implementation

Friday, September 20

Review and Discussion

Next Steps

The workshop used various procedures to accomplish its mission. The discussion of work measurement issues evolved as the week progressed. The results of each day's discussion were the driver for determining the procedures used each succeeding day. In this way the group could build upon accomplishments and discoveries as they happened. This approach allowed the group to be effective and productive.

In order to update everyone on the Project and to provide a common context for the work of the week, various results of the DPPI Project, Phase I and II, were presented and discussed. Following this, the documentation of the current (As-Is) situation of the work measurement discipline was presented for validation and enhancement—with a focus on the Sections on opportunities for improvements ("where it is broken and needing fixing") and recommendations for making improvements.

The group used this previous analysis to assist in developing a proposed improved (To-Be) work measurement discipline. The first approach used was to try to model the processes (activities) of this discipline. However, after much group discussion, it was determined that most of the improvements consisted of changes in concepts, approaches, and relationships with a variety of management decisions at a variety of organizational levels. The IDEF modeling technique selected for use in this Project did not lend itself readily to describing these types of improvements. The group decided not to create a "To-Be" model during the workshop.

The next approach was to develop a new concept for work measurement, rather than just develop new processes and products.

> *(Based on the discussion of the new concept, an IDEF0 model will be created and mapped to the Phase I To-Be model. Thus the "business area" is described first and modeled second, rather than being modeled first and described second that is the normal procedure.)*

First the group described what should constitute a "work time factor" and a "total manpower factor." Next the group developed a description of how "work time factors" are to be used in planning, operating, assessing, and enhancing performance at the various levels of the Work Center, Installation, Major Command, and Component. Then the same was done for "total manpower factor." Following this, the group discussed and described the functions and services that are To-Be provided by the improved work measurement discipline and its practitioners, including possible ways that these services and

practitioners might be structured. As a result, a new name and program for this discipline were developed. These are presented in Section 3.3.

Next the working group considered what was needed to support this new concept/program of work measurement in terms of technology and policy. Rather than focusing on a specific system, the group discussed the general nature of functional requirements for any automated support system for the work measurement discipline. In terms of policy, the group identified ways and items by which policy could assist the development and functioning of the new work measurement concept and design.

At the final workshop session, the results of the working group's discussions were presented to the advisees for their observations and comments. This "3rd-party" participation provided an opportunity to clarify, refine, and enhance the discussions and conclusions of the previous sessions.

3.2.6.1 Results

The new concept for a redesigned work measurement discipline is presented in Section 3.3 and possible implications of this redesign are presented in Section 3.4 below. At this point, only some general, overall observations are provided.

In this workshop, the nature and extent of the transition and expansion of the discipline of work became even more evident. There is great variety and flexibility in the methods used to develop time and manpower factors, in the kinds of f actors being developed and in the levels of precision of the factors being developed. The discipline is responding to the changing needs of management for time and manpower factors and is seeking to be of assistance to managers as they become more and more concerned with the results of their performance. That is, the redesign of the work measurement discipline is underway in DoD.

This workshop, as just one step in this redesigning process, provided a means to bring increased clarity, focus, impetus and direction to this on-going process of redesign. It brought together practitioners from across the various components and the sub-disciplines of traditional labor standards and staffing standards/requirements. No final consensus was reached as to the nature, description, function or structure of this new concept. But a general outline, description, and direction were identified as a basis for further development and action. In addition, the beginning teamwork for such an effort was initiated. It is clear now that this transition and redesign are an interactive process—involving practitioners, managers, management decision structures, oversight organizations, and policy—which will take time to come to maturity.

3.3 Redesigned Concept: "Defense Performance Engineering Support" (DPES)

3.3.1 Introduction

The Redesign Workshop began the task of compiling the information on various changes and improvements that have been occurring and continue to occur in the area of work measurement (development and use of labor and staffing standards). This process also addressed the need for change in how work measurement is performed and began to

formulate improvements for the discipline in the future. Because of the profound nature of the changes, not only in the work measurement discipline but also in the DoD management environment, the proposed improvements are more of a "redesign" than of "incremental changes." The proposed change is more of a conceptual change rather than just changes in some processes. This is reflected in the renaming of this discipline as DPES.

This Section describes the redesigned concept for the work measurement discipline. <u>The primary contribution of the "work measurement and standards people" is first analyzing and measuring the work input of work processes, time factors (coefficients), and manpower factors (coefficients) and then providing consulting services for their use in the activities of planning for results, producing results, assessing results and enhancing results.</u>

> *(The word "results" in this document means the efficient and effective output of products and/or services using the most efficient and effective processes and organization. "Results" means providing what the customer requires, when the customer requires it, and at a competitive cost. In other words, "results" is making sure that the tax payers are getting their money's worth.)*

The basic management philosophy behind this is approach is:

> *"You cannot manage that which you cannot count. You cannot count that which you cannot or do not measure."*

This philosophy assumes that a manager is concerned with performance results (producing products and services effectively and efficiently).

Accordingly, work input measurement has value only to the degree that management has decided to manage by performance results. (This is opposed to managing just by "budget".) It is critical to keep this in mind for three reasons:

- The development of work measured input (primarily time and manpower factors) is not an end in itself, but a method to meet management's needs.

- It will not be helpful to attempt to require/force management to use time and manpower factors where management is not counting results.

- Efforts to promote the use of work input measurement needs to focus on helping the manager realize the value of managing for results and on tying work input measurement to the kind of results management is concerned about.

3.3.2 Terms

Descriptions of most of the terms used in connection with DPES are found in the glossary for the IDEF0 To-Be model (Appendix C). The glossary contains the names and definitions for the activities (boxes) and arrows (Inputs, Controls, Outputs and Mechanisms) of the IDEF model. The terms presented in this paragraph require further discussion or may not be included in the glossary.

3.3.2.1 Work Time Factor

A *"work time factor"* (i.e., standard time, labor standards) is the target time required to accomplish a defined unit of work of acceptable quality by a trained worker (or group of workers) working at a normal pace under average or specified conditions. Documentation for a work time factor will include work content description for the given unit of work along with a record of (an audit trail to) the technique/methodology used to develop the target time, reference material and allowances (if applicable).

> *(The word "factor" is used rather than "standard". The word "standard" in reference to "time" often communicates only narrow, precisely "engineered labor standards" and is associated only with "touch labor" type of units of work. The word "factor" in reference to "time" seeks to communicate the amount of time, however determined, associated with any type of unit of work—from a single motion to the results of a whole project, from seconds to days. The word "factor" also seeks to high-light the primary end-object— the required time expresses as a numeric coefficient or value factor which is used in calculations.)*

All work takes time. A work time factor can be developed at any level of management for the work units of work that are broken down, defined and managed at that level. (That is, a work time factor may be for a motion, like turn a wrench, or for a whole job, like produce a study.) The time factors may be historic baseline factors that are used to manage work and from which improvement is measured. Any one of the many time measurement techniques may be employed, including professional estimates based on experience. The critical (and new) requirement is that there be a documented audit trail to identify the technique used in developing the work time factor.

A work time factor includes engineered labor standards (class-A), class-B labor standards, class-C labor standards, cycle time, elapsed time, and total time. Work time factors may be set at the level, type and precision necessary for managers to plan their mission/work and to achieve desired performance results. Work time factors are developed at the level of detail and precision that provides value-added assistance to the manager of the work.

3.3.2.2 Total Manpower Factor

A *"total manpower factor"* (i.e., staffing standards, staffing requirements) is the target amount of DoD manpower (or equivalents) required to accomplish a given workload within a specific organizational entity. Documentation for total manpower factors will include the documented work content description for a given unit of work along with an audit trail to the technique used to develop the target number of people needed.

Other words for "manpower" are "staff," and "forces,". "Manpower" refers to any human (gender neutral) effort needed to accomplish the mission (produce products or services) of the DoD. "Manpower" refers to "places" needed to accomplish work, not "faces" of personnel to do the work. The word "total" emphasizes that this factor includes military, civilian, contractor, and other people—in-house or out-house—whose efforts are used to accomplish the DoD's mission.

(The word "factor" rather than "standard" is used here also. The word "standard" in reference to "manpower" often refers only to engineered algorithms and formulas for converting certain workloads into man-hours. The word "factor" in reference to "manpower" seeks to communicate the amount of human effort, however determined, associated with any type of unit of work—from a single motion to the results of a whole project. The word "factor" also seeks to high-light the primary end-object—the required manpower expresses as a numeric coefficient or value factor which is used in work force calculations.)

All work takes manpower. A total manpower factor can be developed at any level of management for the units of work that are broken down, defined and managed at that level. (That is, a total manpower factor may be for a task, like change the oil, or for a whole job, like produce a study.) The manpower factors may be baseline factors that are used to manage work and from which improvement is measured. Any one of the many manpower measurement techniques may be employed, including professional estimates based on experience. The critical (and new) requirement is that there be a documented audit trail to the technique used in developing the work time factor.

Most manpower factors will be developed at the Work Center level and will include job skill, skill level, and pay plan along with the number of people per job category (officer, enlisted, civilian, and other--including contractor Full Time Equivalent (FTE)). These factors can then be rolled up and stated at higher levels of management planning and decision making. There are other situations where total manpower factors are developed at higher levels of management—for example, manpower factors related to job design, situations where roll-up manpower factors are not available or necessary, or where a Rough Order of Magnitude (ROM) is all that is needed.

3.3.2.3 Work Standard

"Work standard" is a new concept as well as a new term. The writing of this document revealed a need for a single term instead of writing both terms "work time factor" and "total manpower factor." Then a conversation with a person developing a "job standard system" for NASA provided a concept that combines the two elements. The "job standard system" developed and used "job standards". A "job standard" included both the time and the manpower required to do a job related to launching a space shuttle. The term "work standard" was coined to both the time and the manpower required to accomplish a unit of work—at any level from 1st order to 8th order.

While work time factors and total manpower factors can be developed and used separately, each unit of work requires both time and manpower. Each factor requires a description of the unit of work for which the required time or manpower is determined. Each unit of work uses both time and manpower. Therefore, it is both reasonable and effective to develop both the time and the manpower factors at the same time. Often one of these factors is a given. Most time factors are set for a single (given) person. Most manpower factors are for a given time period—for example, a year or a month. Where one factor is dependent on the other factor for its value, they are developed together.

Thus, it is appropriate in the redesign of the work measurement discipline to have a single "standard" that contains both the required work time factor and the required total

manpower factor. This single "standard" would be composed of a description of the given unit of work, the time required to do the work, the skills to do the work and the amount of manpower to do the work. This single "standard" is called a "work standard." The "work standard" may be developed primarily as a work time factor or as a total manpower factor; but each would contain the same basic information elements with more detail information particular to its primary focus.

In the As-Is model and Baseline Analysis of the work measurement discipline, the term "work standard" was used as a composite term which referred to labor standards and/or staffing standards. In this To-Be Improved Design, "work standard" is a single standard that includes both the time factor and the manpower factor for a described unit of work.

3.3.2.4 Workload

In this document, the term "*workload*" includes the description of the mission/function/task(s) (units of work) of an organizational entity along with the quantity and quality of products/services to be accomplished within a given time period for each unit of work. This quantity and quality of products/services may be stated either in terms of a level of effort required or in terms of the total output required.

As to the IDEF diagram, the workload information is contained (and carried) in all plans and programs. Management and planning begins with a basic workload provided in "General Plans, Programs." This workload is developed, broken down and/or distributed through "Planning Information," "Strategic Plan," "Performance Plan," and "Specific Program."

3.3.2.5 Management Plans and Levels

Mundel states, "motions and time study techniques are neither managerial processes nor a substitute for it, but are a series of techniques that may be usefully employed to assist in the performance of many of the steps in the managerial process." The same can be said for the development of total manpower factors. Also, as the USA Management Engineering College course book for "Defense Work Methods and Standards", Vol. II, page 1-6 states, work measurement provides data and information to most all the manage control cycle (read "performance management processes"), but is itself not part of the management control cycle. In "Defense Work Methods and Standards", Vol. I pages 1-25 to 1-31, methods study and work measurement are described as interfacing with management processes. Information and data from methods study and work measurement (WS) are used by management processes in the functions of forecasting, accepting jobs, job planning, resource planning, scheduling, evaluating progress and replanning/rescheduling. In summary, the tools and techniques of methods study and work measurement are useful and essential in effective work planning and control, but they are only two of many tools, techniques and disciplines that are useful in work planning and control.

The distinction between Performance Engineering (PE) as a management support function and the primary processes of performance management must be carefully maintained. The management processes must be considered, though, because the development of WS is driven by the use these standards by management and because PE personnel and techniques assist managers in various management processes.

The primary management process that uses time and manpower factors is planning (activity A1 in the To-Be Activity Model). The planning process, with its various phases, types and management levels of plans, presents the area of greatest potential for confusion and vagueness. Without a clear and precise differentiation of plans, the confusion extends on to the reporting of results (A2) and to oversight and assessment of results (A3).

The IDEF model is only a graphical presentation of the business processes. It does not depict levels, types and phases of a process in its diagrams. Therefore, further description and distinctions of the levels, types and phases of management planning need to be made textually.

3.3.2.5.1 Levels of Management

There are various levels of management where planning takes place and which are supported by PE. These levels are summarized with the following four terms:

- DoD Component: An OSD, Field Activities or Joint Chief of Staff, Defense Agencies, Joint Service Schools, and the Departments or specific military services (Army, Navy, and Air Force).

- Major Command (MAJCOM): The various major commands of the services, the Commander-In-Chiefs (CINCs), and major sub-division of agencies

- Installation: Military command having custodial responsibilities for land and buildings, and receives base operations support funding to accomplish those assigned support missions.

- Work Center: The particular grouping of similar work/tasks. The place where work is done, products and services produced. This includes Manpower Operation Specialty (MOS) and "Units." This also includes "programs", "functions" and "projects".

While these categories may not be exact or exhaustive, they served as a general delineation and example of the management hierarchy that is involved in developing plans.

3.3.2.5.2 Types of Plans

There are various types of plans that may be produced at the various levels. These are summarized by the following types.

- Strategic Plans: This type includes all macro type plans—both in terms of time and scope. These are major mission plans, expectations and goals. GPRA-required strategic plans are included in this type of plan.

- Performance Plans: This type includes, all micro type plans—both in terms of time and scope. It includes plans ranging from next year's plan for the Air Force, to this year's estimate or schedule for a depot's work, to the work schedule to repair five tanks or paint ten barracks, to "taskers" and "job orders." "Performance Plans" are basically work forecasting/estimation and work execution plans. GPRA-required one year performance plan is included in this type of plan.

- Programs: This type of plan includes the various steps and levels in developing programs and their plans—basically the Performance Objectives Memorandum (POM) process.

- Budgets: This type of plan includes the various steps and levels of developing budgets—in particular, the Planning, PPBS process.

3.3.2.5.3 Phases of Planning

Within each type of plan there are various phases through which a plan proceeds as well as between the various levels of planning. These are summarized by the following general phases. These phases are not necessarily sequential or exclusive. There is extensive interaction and feedback between various phases and various levels.

- Propose Results: These are the first steps in planning—planning for 'out years'. This is what is being proposed to be done along with the request for the resources to do it. This is basically bottom-up participation in the POM and PBBS type planning.

- Distribute Results: This is planning for the distribution of available resources and workload. These are the discussions/plans which allot/distribute the workload and resources (basically people and money)—from the top down to the bottom of management levels (Congress to the line manager).

- Plan to Produce Results: This is the planning and assigning of the allotted workload, people and funding in order to get the work done (this year, this quarter, this week). These are also the results (products/services) that are to be produced with given the workload, money and manpower. These are the production or operation plans—the work instructions and taskers. This phase of planning is performed at all levels, but it is done more extensively at the lower levels of management—those concerned with "getting the product/service out the door" and to the customer.

As we proceed to define how PE, work time factors and total manpower factors relate to these various levels, types, and phases of planning, it will be necessary to keep these distinctions in mind.

3.3.2.6 Performance Measures and Expectations (e.g., Goals).

While Performance Measures and Expectations are an inclusive component of Performance plans, they have been singled out in order to show where they are developed and how they are used in Managing Performance. While these are specific GPRA terms, the subject of the development and use of performance measures and quantitative goals is currently receiving widespread attention from management.

- Performance Measures in the context of this document is a generic term referring to the indicators and/or metrics to be used in measuring products and services (output results)—both planned and actual. Performance measures indicate what is to be measured and how it is to be measured. While work time factors or total manpower factors may sometimes be **used** as performance measures, time and manpower factors **are not** performance measures. (Time and manpower factors are input measures. Performance measures are output

measures.) If time and manpower factors are used as performance measures, it is the result of a planning process, not a work measurement process.

- <u>Performance Expectations</u> are the quantitative targeted values to be achieved for each of the performance measures within a given period of time. While work time factors and total manpower factor values may sometimes be used as performance goals, these factors are not performance goals. (Also it is helpful to distinguish between a "standard" that is used as a common unit of measure—a first down is 10 yards—and a "standard" that is used as a benchmark toward which one strives and against which achievement will be measured—"the fullback's standard for a successful season is 1200 rushing yards".) Time and manpower factors are "standards" in the first sense—common units of measure. They may be used in the second sense (as goals), but this is a result of the planning processes which takes a time or manpower factor value and uses that value as a benchmark value.

Together, performance measurements and goals indicate to management and other personnel if the work has or has not been successfully performed.

Performance measures and goals can and will be established at all levels of management and all levels of the work breakdown structure—at any point and level where it is important and significant to determine if work has been successfully performed. However, it should be noted that a sub-unit may successfully meet its goal(s), but the larger unit may still fail to meet its goals.

3.3.3 DPES Components

DPES encompasses several different types of existing personnel, configurations, and services.

The personnel who provide DPES are IEs, MEs, MAs and similar types of personnel.

Some IEs work in industrial engineering shops at installations, depots or Work Centers providing DPES services to all levels of production managers. Other IEs work in component/function wide configurations/centers and provide services, data and tools to support local industrial engineering shops and personnel. They also support senior management in the planning and assessment of work processes.

MEs and MAs work at the component and MAJCOM level configurations/centers to provide DPES services to the managers of installations, major military structures and Work Centers in analyzing, improving, and staffing their organizations. They also provide DPES services in support of higher level planning and assessment. Other management engineers work in various military structure headquarters to provide "manpower" type services and support to the local management levels.

Traditionally, the IEs focused on work time factors and the MEs focused on total manpower factors. This distinction is still true in general. However more often both these communities find they are having to deal both with time factors and manpower factors. Furthermore, both these communities are providing an increasing amount of work analysis and improvement type services in support of improvement and streamlining efforts to meet downsizing and budget reductions and of the 'continual improvement' management philosophy.

3.3.4 DPES Activities

The activities (processes) of providing DPES and their relationship with the other activities of <u>Manage Performance (Support)</u> are described by an IDEF0 (Activity) model which is included as Appendix C. This model is an enhancement of the DPPI Phase I To-Be model. This enhancement is a result of:

- Updates from a more detailed analysis of the work measurement discipline

- Adding activities, arrows, and interrelationships which are specific to DPES

A glossary of the terms used in the diagrams is also provided in Appendix C.

In this model, Activity A5 models the processes of <u>Provide Defense Performance Engineering Support</u> (A5). Providing DPES is one of several Defense Performance Management Support activities. Therefore the activity A5 (<u>Provide DPES</u>), which is described here, is not a decomposition of the Phase I To-Be model A5: <u>Support Defense Performance Management</u>; but rather <u>Provide DPES</u> is a specific example of <u>Support Defense Performance Management</u>.

The purpose of this Section is to provide a textual description and discussion of <u>Provide Defense Performance Engineering Support</u> which is depicted graphically in the IDEF0 model

3.3.4.1 Provide Defense Performance Engineering Support (A5)

The major function and product of <u>Provide Defense Performance Engineering Support</u> is to develop WS (work process descriptions, time factors and manpower factors) for accomplishing workloads efficiently and effectively. PE encompasses services which support and assist management in making use of WS in planning decisions (all levels, types and phases). PE also provides assistance to management in the use of work measurement/WS data and information in:

- Assessing workload performance results in comparison to performance plans

- Enhancing performance through the use of methods and tools for work analysis and improvement

As such, DPES functions in a management consulting role. In addition, DPES provides organizational systems optimization and improved management as well as promoting its services in support of this vision. PE Support also provides PE data support for its services.

> *(NOTE: There are many other aspects, variables, and factors besides work processes, time factors and manpower factors involved in planning, assessing, and enhancing performance of mission. Work process analysis, work time factors and total manpower factors are only three tools, among many, that managers use in managing performance.)*

3.3.4.2 Manage Performance Engineering (A5.1)

This is the activity of planning and assessing the efforts to provide PE support and services to the various entities who manage performance and to the various processes of

performance management. In response to requests or requirements for services to support management, PE personnel assist mangers in determining the type and level of work and management to be addressed, the type(s) of time/manpower factors and method(s) of development that are most appropriate (value added), and/or the type of assistance that PE can best provide for management. This dialogue is a two-way street. It not only helps the manager understand their needs and the PE services, it also matches the expertise of the PE to the manager's needs. Once the type and level of service has been determined, detailed plans for delivery are made and personnel are assigned to provide the services.

The other aspect of Managing Performance Engineering is planning for the pro-active efforts to expand and promote the PE services to be of assistance to managers. It also includes planning efforts to provide various kinds of data support to the PE services.

Once the DPES efforts are underway, PE management oversees and assesses each PE effort against its plans.

3.3.4.3 Develop Work Standards (A5.2)

WS are developed by first describing the given unit(s) of work and then developing time and manpower factors for the described work. This activity is accomplished by applying the methods of development and the level of precision that were determined in consultation with management. Often the development of the time and manpower factors involves the application of existing factors or generic factors to the particular Work Center or work description. Each work standard is fully documented including references to the method(s) of development.

The development of WS also involves the creation of generic cross function or cross task WS that can be used by anyone performing similar functions or tasks. This involves using and promoting a systems approach to work analysis and management.

While performing analysis and description of the work to be measured, performance engineers may identify and recommend improvements in the work process(es). Until these or other improvements are authorized and implemented, the unimproved (As-Is) process(es) are measured and used in developing standards.

3.3.4.4 Promote Performance Engineering (A5.3)

This is the activity of packaging and marketing the services of PE. It also involves efforts to inform and educate management as to the nature and uses of PE capabilities and their benefits to performance management. Specifically, this will assist managers understand the benefits resulting from applying WS. This activity also seeks to promote the idea of management by results and the importance of establishing and maintaining the links between workload, manpower, money and time at and between all management levels.

3.3.4.5 Expand PE Services (A5.4)

This is the activity of increasing the depth, breath, and proficiency of services to be delivered as well as delivering these services. This applies to enhancing existing services as well as developing additional services. As the research and development dynamic of DPES, this activity expands and refines existing methods and techniques. In addition, new

methods and techniques are researched, developed, tested, packaged and made available for marketing. This is the activity of developing and maintaining a repository of skills and services for assisting managers in the use of work measurement tools and data in the planning, execution, assessment, and enhancement of performance results.

The following list provides examples of services and functions which DPES has and/or will expand capability to assist managers. The operative word is "assistance," meaning DPES personnel function as part of a team effort in performance management.

- Assisting in strategic planning and change implementations

- Assisting with "What-if" scenarios/modeling

- Using WS in forecasting/calculating workload projections, schedules and related manpower

- Assisting in the preparation of performance measures and goals as well as other means for measuring and tracking/monitoring performance

- Assisting, from a time/manpower factor perspective, in preparing proposed plans, distribution plans, production plans, engineering plans, etc.

- Assisting managers with tracking, monitoring and evaluating performance results against projected plans

- Doing variance analysis

- Auditing total manpower usage

- Providing analysis of time/manpower related performance results with feedback to managers and to time/manpower factor systems

- Assisting in assessing compliance with GPRA goals at all levels

- Providing process and resource analysis

- Providing a central point for various work analysis/improvement tools and services such as BPR, FPI, ABC, Flow charting, Economic Analysis, Performance Reviews, Management Analysis (e.g., ERs), Organizational Analysis (e.g., MOEs) , Work Structure Analysis, etc., along with related software support

- Providing Quality Leadership/Improvement tools and services

- Managing A76, PECI and Suggestions Programs

3.3.4.6 Provide Performance Engineering Data Support (A5.5)

Automated support significantly lowers the cost and increases the speed and ease of developing WS. Data repositories of existing and generic work breakdown structures, time factors and manpower factors—along with expert systems for applying them—are developed and maintained. Applications for developing and maintaining time and manpower factors at the appropriate level are developed and maintained. Standard data requirements for WS are developed and promoted. Performance management systems for planning, execution and assessment that make use of time and manpower factors/data

are promoted. Where possible, interface between time and manpower factor databases/systems and performance management systems are developed/promoted.

Therefore, this activity provides the research, development and maintenance of automated tools in support of the development and use of WS. Also, other automated tools to assist in work analysis and improvement are maintained and made available to support PE services.

3.3.5 DPES Integration

The various functions, activities and services of DPES described in Section 3.3.3 above interrelate with each other at different levels of the management structure as well as within each level. Since the descriptions in Section 3.3.3 and the diagrams in Appendix C are not able to depict such interrelations, this Section attempts to describe the integration among the various activities of DPES.

Because WS and other PE support are directly related to a level of work breakdown, such services and support may be provided from the "work deck" up to headquarters. Whether operating from a centralized "repository" of services and skills or from a "field" office, PEs provide a basic suite of services. They may focus on supporting production and line managers in preparing forecasts, estimates, schedules and work execution instructions and assessing the same. Or they may focus on assisting management of installations and major functions with such things as strategic plans, programs, and analysis of past performances. In order to manage the impact of changes at one level upon the results at another level, PE support will be used to assist in translating and tracking these changes between all these levels and phases of management as they relate to processes, time, and manpower.

Because work analysis and improvement are basic to developing WS, PEs will provide assistance with work improvement at all levels—from improving methods for fulfilling orders by a warehouse to improving the functions of an Air Force Wing. Sometimes this will precede the development of WS, sometimes it will result from developing WS, and sometimes improvement will be the primary focus of their service. Because economic analysis and accounting are more and more based upon activities PEs also provide economic analysis methods, tools, and services.

Once PEs have provided assistance in developing plans, they are likely to be called upon to assist in monitoring the progress and analyzing the performance results of these plans. As more and more managers are concerned with performance results, PE support will more and more be desired in monitoring and analyzing performance results for exceptions and developing corrective action. This service may be provided on a day-to-day basis for a production manager or on a quarterly basis for installation and major command commanders.

As management "sharpens its pencil" to respond effectively to downsizing, reduced budgets and competition, PE support will be needed to develop projections, estimates, and implementation plans in close coordination with each other. Also this coordination will need to be maintained up and down the chain of command as changes in one unit of work or level has impact on the performance of another unit of work or level.

In order to develop data repositories of common or generic WS, cooperation between all locations and levels of PEs will be necessary. Furthermore, in order to refine, enhance, and expand PE services, cooperation and coordination between all PEs will be required. With coordination and sharing of personnel, the availability of skills and services can be expanded, promotion and marketing can be increased, and experience can be shared. The Internet and web sites will be two of the tools to assist such coordination and sharing.

All management (at any level) involves the integration of work processes, time and manpower to accomplish a workload. Therefore the integrated analysis of work breakdown, work processes, workload, time, and manpower is critical for management. It needs to be done only to the degree necessary for effective management—not just to be doing it for "doings sake." This is the challenge and contribution of DPES.

3.3.6 DPES Interfaces

As noted earlier, the activities and services provided by DPES are not the managerial process, but they may be usefully employed to assist management in performing many aspects of the managerial processes. Thus DPES interfaces with DoD management processes at all levels. While the main contribution of DPES is work analysis and the development of WS, DPES also provides assistance to managers in the use of the WS for developing projections of performance results (planning), in assessing performance results relative to time, manpower and processes, and in enhancing performance for better results.

However, as noted previously, the model diagrams do not depict the various levels, types, and phases of planning (see 3.3.2.5 above for descriptions) and assessment. Therefore, this Section describes the major points of interface with management.

3.3.6.1 Planning

Results (products, services and expended resources) are produced at the Work Center level. This is where most WS are developed, applied, and used for proposal, distribution and production planning phases (of strategic, performance, programming and budgeting planning types). It is at the Work Center where there is close linkage between time, manpower and workload. Work descriptions, time and manpower factor values, and workload values must be accurately determined and calculated with respect to each other, along with their relationship to dollars and other input factors, (total input) for successful performance results (total output). DPES interfaces extensively with managers at this level. Specific areas requiring assistance and use of work measurement information input are cost estimates, scheduling, strategic and tactical planning, participation in the POM process, readiness requirements, distribution and redistribution of resources (especially manpower) determining training needs, and determining acquisitions.

As management decisions progress through the various types and phases of planning with on-going negotiation and feedback among the different decisions being made, the relationship of workload, time, manpower, and dollars to each other and to performance results (here after referred to by the phrase "performance linkages") needs to be maintained. The critical factor is that a change in one component value in the relationship/calculation dramatically impacts the other components and the performance

results. While these are strictly management processes and decisions, DPES can provide vital assistance in establishing and maintaining the "performance linkages" and in assessing the impact of changes in any of the component values.

Maintaining the "performance linkages" at one level is challenging enough. However, as these types and phases of planning move up and down the levels of management (with negotiation and feedback) from Work Center to OSD, the challenge of establishing and maintaining the "performance linkage" increases. As the values and calculations move between levels and through planning phases, they are sometimes rolled-up and broken down (or otherwise adjusted). At other times these values and calculations are "translated" into other values and calculations, which adds to the complexity and challenge of maintaining consistency.

Of particular concern is the relationship/linkage between the lower level workload (where WS are commonly developed and used) and the more macro level performance goals used in GPRA reporting and for readiness purposes. The lack of "performance linkage" between the Work Center level and the PPBS decision making or readiness measures level is, as one working group member stated, "reflected by the fact that resources (dollars and manpower) are allocated and reduced without corresponding reductions in workload/missions (or the associated GPRS performance goals)—for example, there is no workload annex to Planning Budget Guidance (PBG). One illustration of establishing "performance linkages" would be to link the Army's 12-step process for developing total manpower factors (at the Work Center level) with the PPBS/GPRA decision making as part of either "performance planning" or "performance assessment."

It has been proposed that DPES provide assistance in establishing and maintaining the "performance linkage" as changes are proposed at the various levels and phases of management planning and through assessing the impact of changes in any of the component values. This is most critical at the higher levels of management where the close relationship of the values and impact of changes in these values is not easily seen or understood. In addition, the "translation" between levels and between planning phases— where the "performance linkages" can easily become lost—must be correctly documented. The budget process is one area where this is particularly true and where DPES can provide valuable assistance.

Other planning assistance that is provided by DPES at a higher level also includes the development of simulation models, base level assessment, establishment of higher level benchmarks, and assistance in determining readiness standards and levels.

3.3.6.2 Assessment

In managing for performance, results are the most critical aspect (since results are the things for which the customer is paying good money). Success or failure is determined by results, not by plans. "Are our customers satisfied?", "Did we accomplish our mission?" or "Did we get our money's worth?" and "Are we ready?" are examples of such results orientated concerns. To determine success or failure, actual results (output and related resources expended) must be compared to projected plans and the results assessed. Deviations (exceptions/variances) from the plans are causes for applying a more critical analysis to determine the reason, so that whatever caused the deviation can be corrected. This is also the only way to determine and validate the accuracy of the planning factors

(particularly the work process, time, and manpower factors) and ensure continued use and reliability. DPES expertise and services are proposed to be applied extensively to assist managers in such assessments of results and in such validation of workload, work process, work time factors, and total manpower factors. DPES will support this oversight function at all levels of management.

For effective and efficient performance, assessment (monitoring of progress, analysis, evaluation and change recommendations) must be done on a regular, on-going basis during production time. To wait until the end (at which time the product/service has been compromised, funds spent, and time expired).to locate a discrepancy is costly and provides no opportunity to make a correction.

This assessment assistance will be provided, with most immediate pay-back results seen, to "process owners" at the Work Center level. At the Work Centers, where there is direct interface with customers and where products and services must be regularly delivered, on-going and regular assessment of progress is critical. Also, it is at the Work Centers where the basic level of readiness is determined and regular assessment of readiness is made. DPES personnel will assist Work Center management, at the level and to the extent that is requested, appropriate and feasible, with on-going monitoring, analysis, and evaluation of production and readiness.

Assessment of performance depends upon historical (actual) performance data. This data and its accuracy are particularly critical for decision making at higher levels. Once the data are available, it must be analyzed, interpreted and evaluated before it can be helpful in decision making. Most managers require assistance in analyzing, interpreting and evaluating performance data and comparing it with previous plans. DPES can provide extensive assistance to management in making this assessment. Currently, such assessment (oversight) is seldom performed--particularly on a regular, on-going basis during execution of plans/projects/production. Thus this would involve a new responsibility both for management and for PE's.

Reporting of performance results involves challenges similar to planning with respect to "performance linkages," roll-ups and "translations" between levels and phases. The critical element in accurate assessment and reporting is making use of the same factors, data elements and means of collecting data that were used in the planning process, so that meaningful comparisons, assessments and reports can be made. DPES can provide assistance in maintaining and assessing the "performance linkages" between levels. They can also assist in producing meaningful reports in support of management decisions. . Currently, such linkages and reporting is seldom. Thus this would involve a new emphasis of responsibility both for management and for PE's.

Total and accurate visibility of all manpower related to performance is critical for managing readiness and performance results and for validation of total manpower factors. This requires the projection, tracking, reporting and assessment of the use of **all** manpower, especially "borrowed military manpower," "fill teams" and contractors. DPES is uniquely equipped to support and assist this type of projection, tracking, reporting and assessment of total manpower and their performance.

DPES assistance relative to "performance linkages" and to assessment/oversight will have particular relevance and benefit to managers in their implementation of GPRA.

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3.3.6.3 Improvement

With techniques and tools for work analysis, it is natural for DPES to provide assistance in the area of performance improvement and enhancement. While most effective at the Work Center level, this support for process, economic, management, and organizational analysis and improvement will be provided at all levels of management functions and cross-functions.

Management at all levels, but particularly at Installation and MAJCOM levels, is concerned with more effective and efficient use of manpower, especially in these times of downsizing. DPES can provide tools and services to assist managers in analyzing and improving their work processes and in determining the effective use of manpower. DPES will establish and maintain repositories of skills and tools to assist in all types of management and performance enhancement efforts from BPR and ABC to Performance Reviews and ERs. These analysis and improvement efforts also provide baselines that can be used for measuring and evaluating improvement. Subsequent analysis and improvements can then be evaluated against these baselines for continuous improvement.

3.4 Potential Implications

The proposed new concept of DPES as the improved redesign of the work input measurement discipline has a variety of potential implications. This new concept falls in line with current shifts and trends in management approaches (e.g., producing results effectively, importance of the customer, team management, problem solving, etc.). As it relates to these shifts and trends, there are particular implications for DPES. In considering the possible ways to implement this new concept, the implications for potential changes relative to organizational forms, policy, training and automated support need be addressed. The potential implications are presented below.

3.4.1 New Trends

There is a growing trend in Government to change from "managing by budget" to "managing by results." Managers are shifting from simply "justifying" their budget requests and proposed performance towards "controlling" their performance to produce desired results. (The GPRA and the National Performance Review [NPR] are major examples of this trend.) Whereas competition and the need to make a profit drives the private sector to exercise close "control" over their performance, the public sector traditionally has not been concerned with profit. Traditionally, the public sector utilizes the distribution of a limited budget to provide services required by the public. Accountability has only been mandated in the area of budget justification and financial accountability. The process of distributing government funds and being accountable for those funds contains a great deal of subjectivity; and performance results are only a small factor in this process. With decreasing funds, a public more concerned about "getting the best value for their tax dollars," downsizing of departments, and competition from the private sector, the concern for better performance results is becoming a strong driving force in the Federal Government and in DoD.

This is where PE becomes a vital part of the process. This provides the tools and services that are valuable to managers who are concerned about results and need to "control" performance to obtain acceptable results. As part of this trend toward "managing by

results," DPES contributes to it and depends upon it to increase the value of PE to managers.

It is important for DPES to be aware of the strengths and limitations of "managing by results" in order to function effectively in this changing environment and make a positive contribution toward this change. This understanding is fundamental in developing realistic expectations for DPES, for operating strategically and tactically, and for recognizing and taking advantage of opportunities to increase the use of its tools and services.

While "managing by results" places the primary focus on the products and services produced by the work, it also addresses the ways funds are used to produce these products and services. Thus, "managing by results" not only asks "did we produce what we planned (or were required) to produce?", but also asks "did we get our money's worth?", and "did we do it better and cheaper than our competitors?" In order to adequately evaluate results in this way, planning must focus not only on proposed products and services but on establishing the relationship between the proposed products and services and the resources required to produce them. These are new concepts for government agencies. In addition, this approach must maintain that relationship all the way through from the beginning process of planning to the end process of accounting for actual performance. PE can assist in providing more accurate planning, for product/service results and in assessing and controlling product/service results to insure they conform with the plan. But DPES is only one member of the "results team." The role of DPES is to provide tools and services to assist decision makers (management). It is not active in making the decisions or controlling the outcome.

While it makes good common sense to manage by results, the traditions and culture of "managing by the budget" (the regulations, the procedures of processing, the means of accounting and oversight, the forms, the software, etc.) are deeply ingrained, strong and powerful. Currently, the management process is driven by budget considerations, not by performance "results." "Drivers" are not easily changed. Furthermore, the changes required (1) to establish, maintain, and account for the relationship (linkage) between products/services and money at all levels of planning and accountability and (2) to shift the focus from proposed budgets to actual results (see "new for government" in the paragraph above) are major changes. These changes in the current culture and system will not be made quickly and will require a tremendous amount of effort.

In addition, "managing by results" shifts the locus of criticality to the Work Center—where resources are actually expended and results are actually produced. The traditional management hierarchy and culture is not only compressed, it is turned upside down. Such change, as it comes, will meet resistance and will not be quickly adopted.

This is not some theoretical discussion. DPES supports these changes, requests these changes, and relies on the implementation of these changes to fulfill its function and remain viable. The establishment of DPES is a long term process requiring incremental improvements. Its success will rely on working with the other players to make the extensive changes necessary within the DoD in order to "manage by results." It will also involve assisting management in transitioning to this new approach and as well as developing strategies to manage opposition to these changes. It also means that DPES is not alone in this effort, but is one part of a larger process of transition within DoD.

The specific and practical implications of this approach are illustrated by the implementation of GPRA, as articulated by a working group member, John Anderson, U.S. Army Force Integration Support Agency (USAFISA), in a report on his participation in the To-Be workshop.

> *"This problem pertaining to the lack of linkage between workload used in standards (at the Work Center level) and the PPBES (and more macro level performance goals used in GPRA reporting) decision making and readiness measures is reflected by the fact that resources (dollars and manpower) are allocated and reduced without corresponding reductions in workload/missions (or associated GPRA performance goals)—for example, there is no workload annex to PBG.*

> *"True performance budgeting as intended by GPRA requires resources be allocated with respect to total workload/performance irrespective of funding source, source of labor, (whether performed by contractor or in-house), or source of organizational support. This is a major culture change from the current practice of only focusing on small slices of specific funding stovepipes. (This might require a contractor work year annex to PBG.)*

> *"The inconsistencies, the complexities of the existing accounting system supporting PPBES decision making are a significant constraint on making a better link between resourcing decisions and workload/performance goals at each level."*

The major focus of DPES is and will continue to be the Work Center level. The Work Center mangers are concerned about accomplishing the mission, with "getting the product out the door," and with keeping the customers happy. DPES tools and services can be invaluable to these managers. The increased importance of DPES' assistance depends, in a large part, upon "performance linkage" being documented and maintained at all levels of management. Though the establishment and implementation of such linkage are outside the scope and authority of DPES, DPES can make recommendations and provide assistance in relation to "performance linkage". Once the use of such linkage is formally established, DPES will provide valuable assistance to management, both in planning for, and oversight/assessment of, this linkage.

Performance management depends upon the measurement of results. In order to measure results, there must be objective products and/or services that can be counted, along with the identification of objective measures and indicators for measuring these products and/or services. In addition, the development and use of WS are most effective when performance results in a substantive, objective product or service. Thus a major aspect of implementing performance management (and using DPES) depends upon the articulation of objective results that have significance to DoD managers. Particularly for DoD this means enabling managers to develop objective readiness indicators at the Work Center level and relate them up and down the levels of decision making. Readiness drives DoD management the way profit drives public sector management.

There is another trend currently taking place today in the area of performance management. It is the trend of moving away from the use of "regulations" as drivers of

managerial actions toward "practical reality" as the main driver of managerial actions. The success of DPES (and of "management by results") depends more upon identifying and supporting the real, practical "bottom-lines" of managers than upon policies and regulations. In promoting and marketing DPES, this will mean clarifying how DPES will assist managers in supporting the "war fighters," in increasing readiness and in reducing cost/time for maintaining weapon systems.

Furthermore DPES is part of the trend toward a team approach to management. This approach focuses on people working together to solve problems rather than simply implementing procedures. Performance Engineering personnel will assist managers by becoming part of the management problem solving team. As a result, both Performance Engineering personnel as well as managers will be learning to play a new role.

In summary, the redesign of the work measurement discipline depends on and is part of some major cultural shifts in the approach to management. The success of DPES depends, in a large measure, upon acceptance of these shifts in approach by the management culture of DoD.

3.4.2 Primary Changes/Concerns

As the working group discussed the implementation of the redesigned DPES, several desired changes and major concerns were articulated. Many of these changes and concerns will be incorporated and discussed in the paragraphs below that deal with implications for policy, organization, and system. The remaining changes/concerns are listed here.

- There is a need to develop and execute a marketing strategy focused on managers to educate them regarding the role of DPES and to allow them to see the benefits of tools and processes used for performance measurement.

- Establish pro-active liaison and conferences with other programs and agencies at all levels. (When such interaction is too late the product/service has been compromised and/or the money has been spent with no opportunity to correct the situation.)

- Look at total performance (workload and dollars, not just dollars alone) and ensure their linkage up and down the management levels.

  (Concern: there is no use in developing workload, time, manpower and dollar data at the lower levels if it is being ignored by decision makers up the line. Also need to have actual data captured at the local level and rolled up properly so that higher level decision makers will have adequate data for decision making.)

  - Address total funds and total labor, irrespective of sources and organizational support.

- Manage by workload and available dollars, not just dollars alone.

  - Broaden "workload" to include "quality" and make provisions for consideration/impact of customer relations. (When dollars or manpower are reduced, product/service quality and customer relations may be reduced

even if quantity of products/services is not reduced.) There needs to be the same level of precision in proposing workload/results as there are in proposing dollars and manpower. Workload projection levels should match WS levels—and then be rolled and/or translated upward.

- Manage the dollars and results at the "micro" level (where resources are used and results are produced)—close to the execution of the work/mission.

- Define the areas where DPES connects with and supports management— become part of the management team. (The Air Force might be an example of a "best practice" of this new approach.)
    - Relate DPES personnel to the "2-3 star" management level to assist better performance management at higher levels.

- Consider and promote "total system" approach and process measurement.
    - Include "quality" type tools and services, FPI, economic analysis and organizational analysis along with "standards" development.
    - Work time and total manpower factors may be baseline factors used to manage work and from which improvement can be measured. The factors could be set at any level of management for the work units that are defined and managed at that level.

- Increase use of simulation models for relating workload, time and manpower.

- Require Chief Financial Officer (CFO) certification in order to receive money. Tie results into CFO certification with audit of development and linkages for time/manpower factors.

- Require that assessment/accounting codes be consistent with planning and extend them to the Work Center level.

3.4.3 Organization

While there was no desire to create a "super" organization or "empire" or even a "program" in the traditional sense for DPES, it was recognized that there needs to be some type of organizational and programmatic identity of this business area. Such identity is important in order to have formal recognition and to receive funding necessary to complete the formulation and launch of the DPES. Also establishing an identity for this business area will provide the means for the oversight that is necessary for its success. Thus it was agreed that a DPES should be formulated under DPSO and funding be requested under this program for the continued development and formulation of DPES.

While it is premature to consider how to structure, organize, or otherwise give form to DPES, numerous ideas were presented during the workshop. These ideas provide some thoughts of potential forms or structures for this business area. These ideas are listed below:

- In order to provide viability as a business/service and to provide certification/validation of staff, DPES needs to be tied to some formal organizational entity.

- DPES should not be a Component-owned service/business or an extension of any existing Industrial Engineering or Management Engineering activity such as AFMEA, NAVMAC, USAFISA, NAVAIR Repository, Air Force Materiel Command (AFMC), etc. Rather DPES should be a DoD-owned business area or service

- A DPES center would be a repository (resource center) of new and better practices for development and use of WS, for work analysis and improvement methods, and for DPES services. Also, it would be a repository of data in support of the same. Some possible characteristics would be:

  - Repository of PE personnel and services.

  - Repository of PE information and tools.

  - PE personnel would be located in field sites and/or locations centralized by Component. They would provide a clearing house for services as well as a repository of skills and assistance.

  - PE personnel may serve as a staff member of an existing Organization/Field/Production staff teams.

  - Ad-hoc teams would deliver assistance as needed.

  - Information resources would be a combination of centralized and local sources.

- Any organizational development will be incremental. Take one step, evaluate; take another, etc.

- A web site/page could be used as a place for "cross feeding" with the use of "home pages" for local resources.

- More regular meetings of the working group with representatives of this discipline from all services. The group should be expanded to include representatives from other organizations most directly involved in implementing performance results management. One of the next steps would be to include the development of a strategic plan for DPES.

- This would be a "fee for service" consulting type of organization.

3.4.4 Policy

One of the major results of this Project will be the issuance of a new DoD policy as an update to or replacement of DODI 5010.34. While policy is not a product of this improvement Project nor the responsibility of the working group, several ideas and suggestions relative to policy were expressed during the workshop. Also some ideas relative to policy changes were collected from the interviews and research performed during the Project. These ideas and suggestions are presented and describe the nature of such a new policy and some of the items that may need to be considered. Some of the areas of concern are in the form of a question as to the feasibility of including such an item in policy and if so, to what extent.

- A great deal of emphasis was placed on the need to have performance measures and goals set at the Work Center level which relate to workload,

manpower, time, results, and dollars; to have actual results measured and assessed against the measures and goals; and to have these linked all the way up and down the management chain.

Specific items include:

- Address the linkage (of dollars, manpower and workload) issue between Performance Management and PPBS

- Provide for accountability for such linkage through plans/budget verified by actual performance results

- Have a workload annex to PPBS

- Identify Statutory basis—currently provided in Title 10 U.S.C. 129, GPRA, and CFO Act

- Include these notions of "performance measurement"/"linkage" as part of the annual CFO certification

The real driver here needs to be oversight/auditing for total performance (not just money) on a regular basis.

Since most of this subject matter was seen as extending beyond the scope of this discipline, discussion with related organizations was seen as critical for implementation.

The basic question is: Is it feasible for policy to effect/require such linkage at higher levels? If so, to what extent?

- Or is a better approach to require PE "consulting/assistance" at higher levels of management and even require PE certification that plans and assessments/reports are based on solid work input measurement? And is this even feasible?

- Provide for a GPRA waiver from FTE and this office would be the only vehicle for granting the waiver, thus providing some oversight and control for performance result management.

- Designate that each component is responsible for establishing the program, funding it, training people, and providing staff.

- Show that it is already under each Under Secretary's description.

- Determine to what extent policy can require that all managers establish or have work breakdown structures and codes for their workload; have performance metrics, indicators and goals for their units of work; and track use of resources against these work codes.

- Do not set/require by policy the class of WS to be used. The range and types could be described and the manager given permission to determine which class/type is most useful for managing their workload. It should be required that the work covered by a WS be described and the technique used in determining the time or manpower factor be documented (see definitions of *work time factor* and *total manpower factor*).

- Determine what policy should say, if anything, about the role and use of PE personnel in assisting management.

- While automated support needs to be addressed in policy, recommendations for this subject need to await the report on proposed system architecture.

- While it was clear that DoD-wide standardization of time and manpower factors was not realistic, policy may want to address ownership of these factors—that is, at what level are they a "standard" and who is responsible in determining the "standardized factor." Work center? Depot? Installation? MAJCOM? Or other?

- Mundel's book, Chapter 32, addresses policy relative to time standards. Would it be feasible in Instructions or a Handbook on DPES to require Components (or lower levels) to establish a policy on the setting and use of time and manpower factors (standards), and that this policy address the items of policy suggested by Mundel's book?

- Historic (actual) performance data is critical for the determination and assessment of meaningful time and manpower factors. To what extent can it be required that Work Centers track and record such data?

- Policy could require Components to make PE personnel and services available for support and assistance to all levels of management.

- Could it be required by policy that all staffing requests (and related budget dollars) be based on PE personnel certified total manpower factors?

- Could it be required by policy that all GPRA and other "Operational Plans" be based on PE personnel certified Units of Work breakdown and work count metrics/indicators and based on documented time and manpower factors?

- Could it be required that all GPRA and other performance based reporting be certified by PE personnel?

In today's environment where people have an established paradigm with respect to policy and regulations and have become "experts in negating the impact" of regulations, what is the value of policy and how can it support DPES? The working group provided some ideas as to the value of such policy. This policy can:

- Establish the DPES concept/program

- State the path to be taken to carry out this "program"

- Raise the visibility of DPES

- Assign responsibility for DPES

- Provide a framework for oversight

- Tie DPES to resources (proposals and accounting) rather than to "fads" or "nice ideas"

- Provide for "rewards" for complying and "punishments" for not complying

3.4.5 Training

The DPPI Phase II As-Is report documented a "lack of trained personnel to develop promote, and use WS."

A discussion of training needs was included in the redesign workshop. The primary focus of the discussion was DoD 5010.31-H "Training Guide For The Management Analyst Industrial Engineering Technician" published by the Defense Productivity Program Office, Office of Assistant Secretary of Defense (MRA & L) dated July 1979.

The group found that limiting the instruction to individuals with classification standards of GS-343 and GS-895 was too restrictive. They found that there are individuals performing IE/MA functions that are not GS-343s or GS-895s and who need to participate in training. Furthermore, it was emphasized that the training level required was more than a few weeks of military service type classes. With the requirement for increased staff in this arena and the need for continual expansion and updating of skills, there is a growing need for on-going training.

There should be an established training program (curriculum) that an individual outside of this field could follow to obtain their certification. In addition, there should be continuing education courses that will enable individuals within this field to keep current with the latest trends and concepts. This will allow individuals from the production environment to migrate to IE/MA by making use of their experience in the application of IE/MA products. The group thought that the concept of progressive steps of education/experience from Apprentice to Journeyman to Master would fit in well with the discipline.

The curriculum should not be limited to government courses but should include appropriate courses taught in state and private colleges and universities, as well as the government learning centers. With the recent interest in "Distributed Learning and "Distance Learning" among major colleges and universities, it may be possible for a person to take a class from a remote institution without leave their work location/installation. The Internet and the World Wide Web could be major players in the distribution of the curriculum as well as the instruction itself. Given the development and expansion of electronic communication, the concept of a 'virtual training center' for DPES would be a real possibility. Existing Service institutions of higher learning would also be a source of training in DPES—for example, Air Force Community College, Air Force Institute of Technology, and the Navy Post-Graduate School.

Training should not be limited to only performance engineering personnel (for example, IEs, MEs, and MAs) but should also be provided for managers. Mangers would need training in performance management and in the use of measurement data and DPES services.

The DPSO will address the issues discussed in the redesign workshop with the intent of updating and reissuing DoD 5010.31-H.

3.4.6 Systems

Since the IG Audit Report No. 95-049, December 8, 1994, recommended standardization and the USD(P&R) response committed their support to completing the standardization of automated industrial engineering techniques, automated systems in support of work measurement is a major concern of this Project. Furthermore, the DPPI Phase II As-Is

report documented an "inconsistent automated data support for development and use of standards." The response to this issue of automated support is the specific focus of Task 2.4 of DPPI Phase II and will be addressed in detail in Section 4 of this report.

With the presence of functional practitioners focusing in the redesign of the work measurement discipline, their input as to the current situation and future needs for automated support of DPES was collected and documented. It was also helpful to begin to identify, as a result of the proposed new concept of DPES, the particular implications and challenges for automated support of DPES.

As can be seen below, a number of existing systems were identified and discussed in relation to the development and use of the standards. When the phrase "Standard System" was used in the redesign workshop there was overriding agreement that no one wanted a "Standard System." It was noted that the emphasis to provide "Standard Systems" is being replaced by an emphasis to have "Standard Data." The "Standard Data" approach would allow for data to be widely shared by many existing systems.

Competition is a reality at some installations. These installations are competing with other government installations and commercial organizations. Even though sharing processes and data may be good for the nation as a whole, it can take away from an installation's competitive advantage and their desire to improve. If any "Standard System" or "Standard Data" approach is to succeed it will need to safeguard data and allow the installations to control ownership of their data and determine with whom it is shared. A more effective approach might be to consider data "Standard Data Elements" rather than "Standard Data Values." Navy shipyards are working to establish common terminology (names and definitions) for work processes, labor standards, and reporting across all shipyards—Navy and commercial. This standard data will give them a baseline that will allow them to discuss issues, provide reports and compare information in a way that is meaningful way across all the shipyards. However, they will not share proprietary standards and values.

Not all installations feel there is a need for change. Some installations have systems that are meeting all their requirements.. The "Standard System" approach used by the Joint Logistics Service Center (JLSC) is directing the use of a system that lacks complete functionality. Such installations have indicated that will need to continue to use their current systems to meet their needs and that the introduction of a new system just complicates the existing environment. This is one of the major potential stumbling blocks when migrating from a legacy system to a more updated system.

The following is a list of existing systems in use today:

- TFMMS (Navy)
- Defense Civilian Personnel Data System
- Manpower Data System
- Manpower Standards Development System
- Resource Planner (Navy: Cherry Point)
- Workload Control System (WCS) (NAVDEP)
- DMS (JLSC) (the word "standard" is no longer used in its name)
- PDMSS (JLSC NTI)

- MRPII
- Production Control System (PCS)
- The Army Authorization Documentation System (TAADS)
- Work Information Management System (Civil Engineering)
- ARMS (Army)
- MS3 Repository (Army)
- Standard Depot System (NAVSEA) (Army)
- Force Builder (Army)
- Structure and Manpower Authorization System (SAMAS) (Army)
- Commercial Activity Management Information System (CAMIS) (Army/Navy) [A76 processing]
- CAIRS (Army) [A76 processing]
- Army Stationing Inventory Plan (ASIP) (Army)
- Army Civilian Personnel System (ACPERS) (Army)
- PROGE (Army) [Feeds PPBS]
- GO26 (Air Force) [Work Control Documents and Process descriptions]
- GO72E (Air Force) [Financial system, provides the 715 Report]
- VMRS (Navy) [Manpower Readiness System]
- WINPAT (Navy)
- DCMC (DLA) [will replace some of the older systems]
- IDEF0 Commercial Tool sets [Air Force AI0 by KBSI]
- IDEF3 Commercial Tool sets [Air Force AI3 by KBSI]
- Simulation (Commercial Tool sets) [ProSim/Witness by KBSI/AT&T Istel]
- PC based "Office" Tool sets
- MDR   Master Data Record (NAS) [Comprehensive system]
- DSS   Distribution Standard System (DLA)
- APCAPS   Automated Personnel, Cost Accounting and Payroll System (DLA)
- LAPERS   [workload from DSS and actuals from the DBMS] (DLA)
- SDS   Standard Depot System (AMC-MEA)
- ACCESS DB (AMCMEA) [Process/Requirements storage in Huntsville]
- AMCMEA [Developing an expert system for setting staffing standards, currently in prototype development]
- FACTS   Lockheed proprietary system

- Global Command and Control System (GCCS) and supporting sub-systems

    (Note: Most of these systems are management systems for planning and control of performance. They make use of data from work standard systems and databases, but are not systems for the development and maintenance of WS.)

For labor standards/work time factors to be meaningful and useful, there needs to be a system for real time tracking/assessment of performance data based upon such standards/factors. Thus the development of time standards/factors needs to be tied to work instructions and scheduling systems that then track actual work time. This system needs to monitor and analyze actual data against planned data. This analysis needs to be available in real time to IE and/or managers for management control of performance. (But this is a performance management system, though critical for the use of WS, is outside the scope of this DPPI Phase II Project. It is within the scope of DPPI Phase I which deals with performance management.)

The challenge is recording actual data. Electronic "start-stop time" recording of time against work and/or labor accounting codes is almost essential. Some approaches for capturing this information exist today, such as "Wands," bar-coded cards, computer log-in, etc.

Currently, "white collar" work time is not tied to or tracked by the work performed. In addition, total manpower factors (staffing standards and staffing requirements) are not closely tied to workloads—at least not electronically. However, one workshop participant noted,

> *"To truly manage based on workload (and not just available funds), tracking of manpower utilization data is needed. Except for contractor data, many existing systems provide rough approximations of manpower utilization data. These existing systems do not accurately reflect where the work is being performed, but only where the employee is assigned."*

The feasibility of relating all personnel to units of work/workload and tracking their utilization is a serious question that requires further investigation.

For complete performance results, accounting and decisions, the "performance linkage" needs to be established electronically and managed electronically "up, down and through the management chain of decisions making. *(One workshop participant suggested that workload/performance links with standards should be part of the schedules used in POM development and in connection with any decisions involving resource allocations.)* In addition, the link between the projected plans and actual plans will need to be made for meaningful comparison and assessment/reporting. This type of electronic linkage will give managers the ability to conduct "what if" scenarios and analysis regarding workloads, workload distribution, resource allocation and impacts of any changes in component values—particularly on readiness.

This type of complete system —with its requirements and authorization, with the policy/regulation changes relative to such linkages, reporting and accounting requirements—is beyond the scope and authority of this Project. However, because measured work input (work processes, work time factors and total manpower factors) is

the basis for such performance management and because work-input factors are validated only by recorded actual data (which completes the loop), such a complete management system is of vital interest to DPES.

The power of systems to enforce a policy and management approach is demonstrated by the power of the PPBS system. Thus a shift to a new management approach will need a new system to undergird it and to enforce/implement it. At the same time, the complexity and inconsistencies that plague the PPBS system and all other DoD major management and accounting systems demonstrate the difficulties and challenges related to the development of any such "complete" performance management system.

3.5 Case for Change Audit Trail

3.5.1 Introduction

The Baseline Analysis (Section 2) identified several OFIs in developing and using WS. These OFIs identified areas of issues and concerns about where the process was not running smoothly or was considered "broken." Considering these OFIs, six recommendations were made to correct and improve the way WS are developed and used. In addition, continued analysis of the current use of WS and the information collected from the redesign workshop provided further OFIs.

This Section reviews these OFIs and improvement recommendations in light of the proposed redesign of the development and use of WS. The following Section discusses how the OFIs were incorporated into the development of the proposed DPES Program.

3.5.2 Opportunities for Improvement

The As-Is Baseline Recommendations were developed in response to the identified OFIs, and an "audit trail" was mapped to them. As the analysis of this Project progressed, the team was able to refine and clarify the OFIs. Therefore the following paragraphs will briefly revisit the OFIs and the response of the DPES design to them.

3.5.2.1 Weak Enforcement

Analysis indicated that WS are generally only being used by certain offices because the nature of the operation requires their use, not because official DoD or Component policy and regulations require them. Throughout the interviews with SME, very little reference was made to any policy and regulations regarding WS expect to note that no effective policy or oversight/enforcement exists.

The proposed redesign seeks to address this OFI by issuing a revised and more relevant policy. Analysis indicates that an effective and updated policy can provide the authorization support necessary for successfully implementing the redesigned concept. In addition it can provide the language that is lacking in the original policy that requires documentation of critical linkages and accountability—for example, linkages between productivity and acquisition of adequate resources. In addition, GPRA must be considered as it may have some impact upon the use and accountability for use of WS. This accountability needs to be addressed in cooperation with other organizational elements within DoD.

As noted by the workshop, the power and use of policy and regulations are limited—DoD managers are well skilled in finding alternative methods for getting around or ignoring policy and regulations. The main driver for improving enforcement is one of survival. With decreasing resources and increasing competition for work, managers need to have more accurate figures for tighter control of their operations.

3.5.2.2 Inconsistent Automated Data Support

While automated support for the development and use of WS is weak, there are efforts underway to improve it. For example, within depot maintenance, the JLSC is developing and implementing improved management systems that require and support the development of time factors. The Navy has developed and is improving systems that support the development of both time factors and manpower factors.

While this aspect of the proposed redesigned DPES will be addressed in the next task of the DPPI Phase II Project, the consensus of the workshop was that a common, standardized system (as in application programs) is not feasible, but that common, standardized data may be. One major function of the redesigned DPES will be to provide performance engineering data support, particularly in the area of repositories of generic and/or common process names, breakdowns and descriptions with time and manpower factors that can then be tailored to specific Work Centers. The other proposed improvement will address the need to link WS with performance management systems as a basis for validation and updating of WS.

The importance of having 'real time' data for ongoing assessment and correction of production outputs was seen to be critical for effective performance management. "Good" WS are necessary for effective control of production. The data are also necessary for validating and updating WS. While such data and systems are outside the scope of this Project, the systems architecture should identify and stress the interface with other production management systems.

3.5.2.3 Misperception of WS by Managers

Investigation at the field level, while supporting all the misperceptions identified in this OFI, revealed that the primary misperception-perception is that managers do not see the value of WS. Their main concern is to "get the work out the door" or "protect their budget/staff." Therefore, they fail to see the value of using WS.

One of the major functions of the redesigned DPES is to promote and market the use of WS in performance management. Another method to address this OFI is to expand and enhance the services of performance engineers in support of performance management.

3.5.2.4 Limited Positive Incentive to Improve Performance

This area can be addressed by establishing linkages to GPRA, by requiring linkages between workload and the development and distribution of budgets, and by supporting process improvements. The activities of DPES in promoting and marketing performance engineering services will also seek to address this OFI. The DPES Program supports the trend to "managing by results" as downsizing and competition make DoD functions operate more as a "market economy" rather than a "budget economy."

While there is little that can be done directly to address the cultural change from "managing by budget" to "managing by results," the issuance of new policies can support the growing trend towards "managing by results."

3.5.2.5 Inadequacy of "Engineered" and "Non-Engineered" as Categories

In actual practice, the old approach of using "precise" engineered standards is being replaced by a more flexible approach in the development and use of time and manpower factors. The trend is toward developing these factors from historic experience and using them more as "baselines" or "benchmarks" from which to begin calculations and projections and from which improvements will be made. Later, these "baselines" will be updated with actual performance data.

This OFI is addressed by the wording in the definitions for *work time factor* and *total manpower factor*. The description of these factors expands the concept that work time factors include not only the small, low order units of work but also cover any and all work processes. It also defines total manpower factors as including any and all personnel associated with any work.

3.5.2.6 Lack of Personnel Trained to Develop, Promote and Use WS.

This OFI was confirmed at every point of the investigation. Staff and training have been radically reduced over the past several years.

The workshop participants stressed the importance of including provisions in the new policy for providing staff positions for DPES and for funding the training of staff for PE.

3.5.3 Recommendations for Improvement

The recommendations presented in the Baseline Analysis were discussed by the workshop participants as they developed the concept for DPES and its functionality. The ideas generated from each recommendation were incorporated in the proposed redesign, though some of the specifics were tempered by the realities of the current operating situation.

3.5.3.1 Guidance

New policy in support of both performance management and DPES will be drafted and "staffed".

The workshop participants presented several ideas with respect to the nature and content of the policy in support of DPES. The critical aspects of accountability, oversight and enforcement were addressed by the need to link DPES and WS with the full range of performance management—particularly workload, resources and performance. This will involve functions outside the scope of this Project and will require the cooperation of various DoD organizational elements other than DPSO. However, the development and content of a policy will need to establish the role of DPES as one of support and assistance to management in managing resources to accomplish workloads. Therefore, the development of a policy, or at least its effective implementation, will require the same DPES-type cooperation, coordination and assistance from the highest to the lowest levels of management.

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3.5.3.2 Matrix of Methods to Work

Continued investigation at field level operations revealed a great variety and flexibility in the use of methods and techniques for developing time and manpower factors. The restrictive classification of engineered and non-engineered standards is inadequate for today's work environment. It is effectively being replaced as managers and engineers develop WS that are most appropriate for each particular situation requiring WS.

Rather than develop a "taxonomy" of standards as recommended by the As-Is report, the redesign addresses this recommendation for more flexibility with a new definition of WS, including the work time factor and the total manpower factor. In addition, instead of emphasizing "standardized" factors, the stress is upon systematic use of structured methods and techniques in the development of any factor and the requirement to document the technique used in developing each factor. This approach recognizes and affirms the flexibility and variety that exists in the "field." This flexibility is needed to make WS a valued added tool for management. It also seeks to bring commonality to the development of WS rather than to the standards themselves.

3.5.3.3 Automated System Support

As noted in Section 3.5.2.2 above, a standard automated system (as in a standard software application and database) in support of the development of WS does not seem desirable or feasible. However, a common or generic architecture (as in standard requirements for common information, data, and functionality) may be feasible. The variety and uniqueness of the many "businesses" within each Service (for example, each installation is a city with many business franchises) makes the development of a standard system for DoD unrealistic. Common requirements, specifications (production design) and tools would be possible to design.

While linkage with management systems is critical for WS development and PE assistance to managers (both for input and for output), such systems are outside the scope of DPPI Phase II. However, such a system is fundamental to the implementation of DDPI Phase I (Defense Performance Management).

3.5.3.4 Centralized Support/Service

The proposed redesigned DPES would combine support of process improvement with the development of WS into a more comprehensive performance engineering support of management. Although the structure of DPES was discussed, no consensus was reached as to the nature of its organization. There would be some type of centralized repository of services and skills. There would also be some form of local/field support to work with center level management. Though there would need to be some type of DoD-wide programmatic identify, at least in the beginning, the operating structure is not yet clear. The exact form and structure of DPES will develop slowly over time in response to the evolving DPES functions.

It was fairly clear that a new "programmatic empire" was not desired or intended. The consensus of the workshop members was that DPES, in its role as a "management consultant," should be adaptable and flexible in providing PE support and services to its "customers."

3.5.3.5 Incentive/Accountability

Primarily, the value of WS and other PE services is based on the value they provide to the improvement of performance results. As improved results are required (by customers and superiors), the more WS and other PE services will be valued. Thus, incentives for the use of DPES basically are derived from the incentive to improve results. Secondarily, relating resource distribution to the use of WS and/or performance would give further incentives to management since they would now be required to justify resource decisions. The revised DODD 5010.31 and DODI 5010.34 will seek to establish such incentives.

The workshop participants addressed the need for accountability through linkage of workload, resources and performance results from beginning to end, from Work Center level development to DoD headquarters level and back down. While such linkage requirements and policy are outside the scope and authority of this Project, this linkage is critical for meaningful management and for making improvements. Therefore, the proposed redesign stresses cooperation with other functions/organizations within DoD to establish and implement such linkage. One or two "hooks" into such accountability that this Project could include in policy were proposed.

3.5.3.6 Marketing/Customer Service

This OFI recommended a more "proactive marketing" effort to inform managers about DPES and to "sell" their services. "Proactive marketing" is a major activity in the design of DPES. This activity will promote and market performance engineering services to all of DoD. As performance engineering, in its new concept, moves more to operating on a "fee for services" basis, it becomes more critical for DPES to market its services and to ensure that they remain a value-added service for the managers (the customer). As one working group member expressed it: "We need to prepare 'a case for action' to show managers how we can be of service to them and can benefit them at a value-added cost." This new design calls for educating all levels of management—from first line supervisors to 4-star generals—in the value and use of performance engineering. DPES also needs to be cost effective in the methods it uses for developing WS and performing analysis.

3.5.4 Additional OFIs and Recommendations from the Workshop

The redesign workshop identified additional OFIs. Their recommendations were incorporated into this document in Sections 3 and 4. Also, these ideas have been mentioned in the audit trail above in support of previous OFIs and Recommendations. The following paragraphs discuss further details regarding these OFIs including their source and main emphasis.

3.5.4.1 Linkage

The primary concern of the workshop, was the fact that workload was used as a basis of projecting performance and determining what resources are needed to accomplish the workload at the Work Center level. However, this linkage was not maintained at higher management decision levels. Thus the impact of reduction of resources upon workload and mission was not seen by upper management. They continued to expect that the original workload would still be completed, despite the reduced resources. Therefore, it was proposed that workload/performance results continue to be linked with resource

requirements and other projections (such as schedule and quality of products and services) throughout all phases and levels of planning and accounting (assessment) for performance.

While this is technically outside of the scope and business of DPES, some aspects of this problem can be addressed in a policy statement. More critically is the need to get the participation and/or cooperation of related offices in implementing DPES and in enabling performance management.

3.5.4.2 Standard Data, Not Standard Systems

The working group members did not express too much concern for standard systems in support of the development of WS. Total manpower factors do not lend themselves well to automated support and there is very little automation used in developing manpower factors. Additionally, most WS are specific to functions and Work Centers. All of this mitigates against the "standardized systems." There was concern to develop data about common/generic processes (with work descriptions and general time and manpower factors) which could be adapted and tailored quickly for specific Work Centers.

This concern and recommendation will be addressed in the System Architecture in Section 4.

3.5.4.3 Baseline Figures, Not Formal Standards

While precise, more formally engineered time factors as fixed standards are helpful in some manufacturing and repair work, most work can be served with less rigorously developed time and manpower factor values that serve more as "baselines" or starting numbers from which to measure and improve. Also, time and manpower factors are being set at higher orders of units of work, which do not require as precise a value as lower units of work. Permission to develop the most appropriate factor values at any level necessary for management is provided in the definition of WS, requiring only the documentation of the structured method used to arrive at the factor value being used.

3.5.4.4 Importance of Actual Performance Data

In order for the "performance linkage' to be meaningful, reliable and useful, the "performance linkage" must be supplied with and validated by actual (historic) performance data. Also, in order to make process improvements and to validate/change WS data of actual performance is needed.

While systems that maintain "performance linkage" and which supply this performance are outside of the scope of DDPI Phase II, it is within the scope of DDPI Phase I.

3.5.4.5 Few Performance Measures Show Deficiency

Because of the lack of linkages and lack of performance data, there is no way to show deficiencies. While it might have been possible in the past to ignore deficiencies, it will be increasingly difficult to do so in the future due to reductions in budgets and increased competition.

3.5.4.6 Performance Engineering "Tool Box"

Part of the new consulting mode for DPES will be the development and use of a PE "tool box" of various analyses and measurement techniques thus enabling the use of "the right tool for the right situation." (This will be part of the DPES process of expanding PE Services.)

3.5.4.7 Show Contractors as Part of Total Force

Most current staffing requirements address only military and civilian staffing requirements. When portions of the workload are contracted out, total workload requirements, analysis, comparisons, and resource utilization cannot be known. For accurate analysis, projections, assessment and accounting, contractors (or FTEs) need to be included. Additional discussion of this OFI is addressed in the definition of *total manpower factor.*

3.5.5 Summary

The redesign and development of DPES as the improvement of the work measurement discipline is a living process. As the proposed redesign is implemented and as it seeks to address the OFIs and implement suggested recommendations, DPES will discover other OFIs and will refine the improvements.

4. WORK MEASUREMENT/LABOR STANDARDS (WS/LS) SYSTEM ARCHITECTURE

4.1 Introduction

4.1.1 Background

The WM/LS System Architecture addresses the need for improvement, standardization of automated industrial engineering techniques for the development and maintenance of labor standards as identified by several IG audit reports (particularly Audit Report No. 95-049) and recommended by Under Secretary of Defense (Personnel and Readiness) (USD/P&R) Dr. Edwin Dorn. This System Architecture is also the first step in addressing the need for improved automated support and sharing of data in the area of WM/LS. The "Case for Change", referred to in Section 1, discusses the state of the work measurement programs in the Military. Some of the observations are:

- All Military Services have some type of work measurement programs.

- They all use some form of standard time data and have a variety of labor standards, but each service uses their own methods and there is a need of better processes for updating and maintaining the standards.

- The level and type of automated support varies.

- These programs do not share data or interact with each other.

- There is a tremendous need to improve the automated support available for WM/LS programs.

- All the data should be standardized and databases should be developed that contain common time and manpower data.

- Networks should be developed to enable easier, more rapid transfer/exchange of data between and within the programs.

- IEs/information analysts should be provided with the necessary processes and tools for developing and using WS.

Following the accepted DISA BPR process, this system architecture is designed to support the improved and redesigned DPES business area. (See Section 3) "Automated industrial engineering techniques," according to IG Audits of several depot maintenance locations, refers to any automated system/application which supports the work measurement discipline—the development, maintenance, accessibility, and management of labor standards. This architecture addresses the recommendations made by the IG to standardize the systems and data being developed and used in the area of labor standards. This project was expanded to include staffing standards along with labor standards. The improved design combines and redefines these two standards as a "work standard." This "work standard" is composed of a defined unit of work, a time factor accounting for the amount of time required to accomplish the work, and a manpower factor accounting for the number of people (military, civilian, contractors, or equivalents) needed to accomplish the work. WS are based upon some form of work analysis and work measurement. Therefore, the system architecture presented here describes an automated system for use in the development and maintenance of WS, including the

preliminary work analysis and work measurement. Until a more formal name is adopted, this system will be referred to as the **"Work Standard Application Package"**[1] **(WSAP).**

4.1.2 Overall Systems and Support Schema

As shown in Figure 8 - Overall Support Schema, the WSAP is only one of many systems supporting the overall schema of Performance Management.

Performance Management	Performance Management Support	Performance Engineering Support
-EIS Executive Information System (e.g. Readiness reporting) -DSS Decision Support Systems (e.g. Planning, Programming, and Budgeting System) -PXAES Systems (Planning, eXecuting, Assessing, Enhancing, and Supporting)	-TOL/M Total Quality Leadership/ Management -FPI/BPR Functional Process Improvement/Business Process Reengineering -ABC Activity Based Costing -EA/FEA Economic Analysis/ Functional Economic Analysis - Performance Eng. Support	WSAP -WM (Motion and Time) -Work Standards Development (Work + Time + People) Other Resources -PECI -PR Performance Review (e.g. ER/MOE) (Efficency Review/Most Efficient Organization) -Workforce Training, Education, Career Development, Motivation, Relations

Figure 8: Overall Support Schema

As shown in the first column of Figure 8 - Overall Support Schema, Performance Management is supported by several different systems. Some of these systems are **Executive Information Systems (EIS), DSS** and the **PPBS**. There is also a vast array of systems which support the basic Performance Management functions of planning, executing, assessing, and enhancing performance as well as providing performance management support. *(These processes are part of the newly modeled business process for Performance Management.)*

Column 2 in Figure 6 - Overall Support Schema lists the tools and automated support available for providing Performance Management Support. These tools and applications mainly support continuous process improvement of DoD functions, processes and organizations. Most of these tools provide methods to develop a baseline of the current

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[1] *The word "package" is used to indicate that an integrated and expandable package of optional components is being proposed rather than a single, monolithic stand-alone computer system. The word "system" when used in connection with the WSAP indicates that the components of the package function together as parts of a single, integrated design or architecture.*

process. PE Support is one particular kind of Performance Management Support. *(There are many other different kinds of support for Performance Management which are not identified here.)*

Within PE Support (column 3), the WSAP provides automated assistance in developing WS which are then used by other management functions. The WSAP also provides assistance in analyzing and measuring work as the basis for building WS. *(There are other activities within PE Support both as described in the improved design of WM/LS and as assigned to the DPSO. But these activities are not addressed here as they do not have special support systems.)* The systems and applications being used currently to develop and maintain labor and staffing standards will be integrated with or replaced by the WSAP.

Though the WSAP is only one small system within Managing Performance, it is integrally related to many of these other systems. The following Sections of this report, along with various diagrams, will describe in more detail the relationships and interfaces between the WSAP and these other systems.

4.1.3 The Defense Industrial Engineering Support System (DIESS)

An earlier Task Group on Work Measurement and Application of Standards also addressed the recommendations from the DoD IG audit reports for the development of a new, standardized automated industrial engineering system. The Task Group proposed to design and develop a new system called DIESS. A general architecture of the DIESS was designed, but the system was never developed.

While DIESS concept was an outgrowth of Computer Aided Time Standards (CATS) and sought to provide automated work measurement assistance, it recognized that Work Measurement alone was not enough. So the design of DIESS sought to foster Work Improvement as well. To this end, the design provided process models for engineering studies, TQM, methods improvement, etc. While it supported the development of various time standards, the design of DIESS went on to support work planning, control and scheduling, and unit costing. It also supported variance analysis and continuous improvement feedback for updates and improvements. Not only was DEISS to serve as a TQM tool, it also was to function as an EIS.

More specifically, the concept for DIESS would provided automated work measurement systems/techniques for:

- Easy and rapid standards update and maintenance
- Consistent, uniform application methodology
- Work planning, tracking work-in progress, controlling and scheduling
- Determining process costs
- Computer assisted methods/process improvement

Based around a "work station" concept, the design for DIESS hardware components and configuration involved a variety of hi-tech capabilities. With an extensive network of communication it would provide a means for sharing/interchange of standards and work measurement data across all components and locations.

DIESS was designed as a comprehensive, monolithic type system to support both the industrial engineer and production manager in work centers where engineered time

standards are applicable and value-added—e.g., repair and maintenance depots, facility maintenance, manufacturing, shipyards, logistic depots, and other situations with statistically reliable workloads. While its functionality was ambitious, DIESS was projected to meet all the identified and desired requirements in the work measurement/labor standards and related production management business areas. The WSAP is not designed to be as comprehensive and complex as was DIESS, but rather it will focus on supporting the PE tasks of work measurement and work standard development. The WSAP will seek to address the concepts and functionality identified in DIESS. This will be discussed in more detail in Section 3.

4.1.4 Overview of Section 4

Section 4 is composed of four additional sub-Sections with more information contained in Appendix D.

Section 4.2, "System Architecture: A Definition," describes a "system architecture." It discusses the three aspects--the Information Architecture, the Data Architecture, and the Technology Architecture--of a System Architecture.

Section 4.3, "WSAP System Architecture and DPES," defines the scope and focus of the WSAP. For meaningful management of data and reliable exchange with other systems, a system must be reliable and valid. This Section focuses on the functionality and general requirements to be supported by the WSAP.

Section 4.4, "Proposed WSAP System Architecture," describes the various components and major elements of the system and how they all work together. It also describes the necessary interfaces and connectivity between the WSAP and other management systems.

Section 4.5, "Alternatives for Implementation," discusses several options for implementing WSAP. Other subjects related to implementing and/or operating the WSAP are also discussed.

Appendix D provides definitions for the various techniques listed in Figure 11 - Process, Information, and System Relationships. Appendix D also provides definitions for automated tools that could be used with the WSAP. These "tools" are either part of a set of available software packages or are stand alone software packages. Inclusion of specific software packages does not necessarily indicate an endorsement of the product.

4.2 System Architecture: A Definition

4.2.1 General

The word "system," in this Section refers to an automated electronic information system. The word "architecture" means a design which shows all the components and requirements of the system and how they fit together. A "system architecture" depicts all the parts and their specifications—how these parts interrelate to compose one single combined automation support system.

A system architecture is used to provide the "blueprint"—the "production specifications" for building the system.. These detailed specifications are provided to the programmers and developers to build and implement the system. Following this, a system architecture is then used for maintaining and/or updating the system. Prior to building the system, a

system architecture is a means for gathering and organizing the various requirements for a system, analyzing and evaluating those requirements, for making decisions about the system and its requirements, and communicating the nature, composition and requirements of the system to others. The development of a system architecture proceeds through various levels of detail from a beginning rough draft or "artist sketch" for a general view of a system through increasing detail to a level of detail necessary for production of the system. A system architecture provides a "picture" of a system at various stages of design which enables people to "see" the system and to make decisions about it. A system architecture, particularly at higher levels, permits "what if" scenarios of various "sizes," complexities, combinations, sophistication, etc., of a system in order to determine what is the most appropriate and feasible automated support for a business area.

A system architecture is composed of three basic sub-architectures: Information Architecture, Data Architecture, and Technology Architecture. The Information Architecture is the user's view of the system and includes:

- User friendly input and output screens to collect, organize and present data

- Transactions which organize and manipulate data to produce results desired by the user

- Questions and answers to be supported (e.g., queries, formats, reports, etc.)

- Automated reporting feature

- Subapplications—combinations of inputs and outputs of data for a particular subject area

- Information/data access and security requirements

- Format requirements for screens and reports

- Process, procedures and work flows to be supported

The Data Architecture is the logical structure of the data to be managed by the system. Examples of this are:

- The types and kind of data required

- Data classes, entities, elements to capture the data values to support the information needs

- Business rules of the relationships and constraints of the data

- Logical data models

- Security, encryption transfer information

The Technology Architecture provides the requirements of all the physical aspects of a system as well as a picture of how all these relate. Examples of this are:

- Physical data models

- Databases and database designs

- Computer hardware, i.e., PC's, servers, mainframes, monitors, bar coding, mechanisms/readers, scanners, palm computers, etc., and their configuration

- Distribution models for data and applications
- Communications technology — Local Area Networks (LANs), Wide Area Networks (WANs), telecommunications, etc.
- Software and operating systems for all the above

The system architecture shows the interrelationship between the three architectures. This provides the ability to see the impact of proposed changes on the various parts of the system, thus allowing for adjustments before final construction. A system architecture also "shows" the interface(s) between a system and other system(s), what is required for such interfaces and how these interfaces will be developed and maintained.

4.2.2 DPPI Phase II

A system architecture begins with a very general "sketch" of a system to meet general, high level requirements. From there the architecture proceeds to greater and greater detail which provides the basis for various decisions regarding the system to be developed. Since DPPI Phase II needs to provide a basis for a decision as to what kind of system, if any, is feasible for supporting the development of WS, an "artist drawing" level of detail for system possibilities will provide enough detail for this first level decision. Therefore this project will develop only a general, high level system architecture. This general system architecture will permit decisions about basic system requirements and how they might best be met. This architecture will allow analysis and evaluation of these general requirements for a work standard development system as well as possible implementations of these requirements. This high level architecture will also "show" the required/desired interfaces with other systems in Performance Management and provide PE services. As such, this high level, WS development system architecture will provide a "vision" of an automated system to support the proposed redesigned concept of DPES.

In the future, if some or all of the system possibilities are deemed feasible and desirable, the next level of detail ("diagrams" of approximate specifications) would need to be designed so that practicalities and costs could be determined and decided upon. Then, following a decision to proceed with development, detail "production specifications" (logical and physical detailed design documents) would be developed. Once these "production specifications" were approved, implementation and testing would commence.

For the purpose of the DPPI Phase II project, the system architecture will be a general architecture or picture of a system for the overall automation support for the development of WS. This system architecture will serve as a basis for decisions in response to the IG audits recommendations for the developing automated support of WM/LS.

4.3 WSAP System Architecture and DPES

4.3.1 Scope and Focus

The "Improved WM/LS Design" (Section 3) and Figure 8 - Overall Support Schema (Section 1), PE Support is one of several kinds of support provided for managing performance. In addition, the WSAP is one of several systems involved in providing support to managers.

But the role of WS in the flow of management information is a critical driver for designing an automated information system. The information flows across all boundaries, functions,

processes, organizations and systems. This flow of information determines the viability of functions, processes, organizations and systems. Therefore for an automated system to be useful it must support this flow of reliable data. The first step in developing a system architecture is to identify the types of required information and how the information flows from place to place. Only by precisely identifying this information and its flow, can an effective, efficient system be designed.

Such delimitation of scope and focus also enhances the ease of system development. It also permits the precise development of requirement interfaces to ensure the flow and the ability to share information.

The primary definition of the information flow for DPES and for WS is described in the IDEF0 "To-Be" model of Provide PE Support within Manage Performance (Support). This model is located in the "Preliminary Improved WM/LS Design" report. Figure 9 - Work Measurement Information Cycle is a simplified diagram of that flow and of the complex information cycle in which WS participate.

DPES participates in this information cycle both directly (through development of WS) and indirectly (by assisting management in planning, controlling, assessing and enhancing performance). This information cycle (See Figure 9 - Work Measurement Information Cycle) begins with (1) analyzing and measuring work to provide data for the next step, and (2) developing WS—both locally and centrally. These standards provide coefficients which are then used in (3) performance management for developing plans (all phases of planning) to accomplish a given workload (usually at the Work Center level) according to a time schedule and employing a particular amount of human and other resources. These plans become (4) "work orders" ('execution paper,' production orders, work instructions, 'taskers,' operation plans, etc.) which inform workers what is to be done. The execution of "work orders" is (5) tracked and actual performance data is collected. The actual performance is periodically compared with the "work orders." The results of this comparison are (6) documented in execution and analysis reports. *(Remember, it is the To-Be process which is being described and supported.)* These comparisons are made periodically in order to control execution (noting exceptions and making adjustments) and ensure successful accomplishment of the assigned workload. One use of the (1) performance/analysis data is for (2) maintaining WS through validation and updating. The historic/assessment data are also used in the (2) development of WS.

> *(Steps 3-6 involve a large variety of automated systems, applications and programs which support both local and higher levels of management. Each Agency, Service, Function, and installation has it own particular set of automated systems ranging from the PPBS system to use of a local spreadsheet package. Together, these numerous systems constitute the current "performance management system").*

This information cycle is the general scope of the overall systems environment for DPES. The focused scope of the System Architecture for WSAP is limited to work analysis and measurement and work standard development and maintenance. The development of WS supplies information to and receives information from the other steps of this cycle. These other steps are part of the performance management information system(s) and are outside the direct responsibility of DPES.

This limited scope is in contrast to the broad scope of the previously designed system in support of WM/LS, DIESS. An examination the design of DIESS reveals that it sought to support this complete information cycle.

- Not only did it support the work of IEs, it also supported planners, estimators, quality control analysts and managers. It also sought to support management functions in controlling staff, projects, tasks, schedules, workload planning, unit cost analysis and research and development.

- In addition to supporting the development and execution of industrial engineering studies and development of time standards, it would support TQM and other improvement efforts, industrial process instructions, hazardous waste minimization, and facilities and equipment planning.

- DIESS would also prepare work planning documents, control and scheduling documents and unit cost information; and provide all standard TQM graphic methods, analytical and management control capabilities, and management of other support functions.

- As an EIS, DIESS would allow management to manage corporate information, analyze business methods, and ensure attainment of performance goals and strategic business plans.

Relative to the general scope of this system, the report on the redesign of DPES emphasizes:

- The development and use of WS is customer (manager) driven

- A modern, real time performance management system is critical for the productive use of WS

However, the experience of the JLSC, the Depot Maintenance Council, and others (reported during interviews and the workshop) indicates that the development of a standard, all-encompassing management system is not feasible, even for the limited environment of depot maintenance. Performance management encompasses all DoD functions. A possible solution is to develop an integrated modular system based on standard data designed to support the broad range of Performance Management. Even so, that would be part of the implementation of DPPI Phase I project (Defense Performance Management), not of this DPPI Phase II project (Work Measurement/WS). Therefore, this architecture for WSAP will focus on work measurement and work standard development, not the full range of performance management.
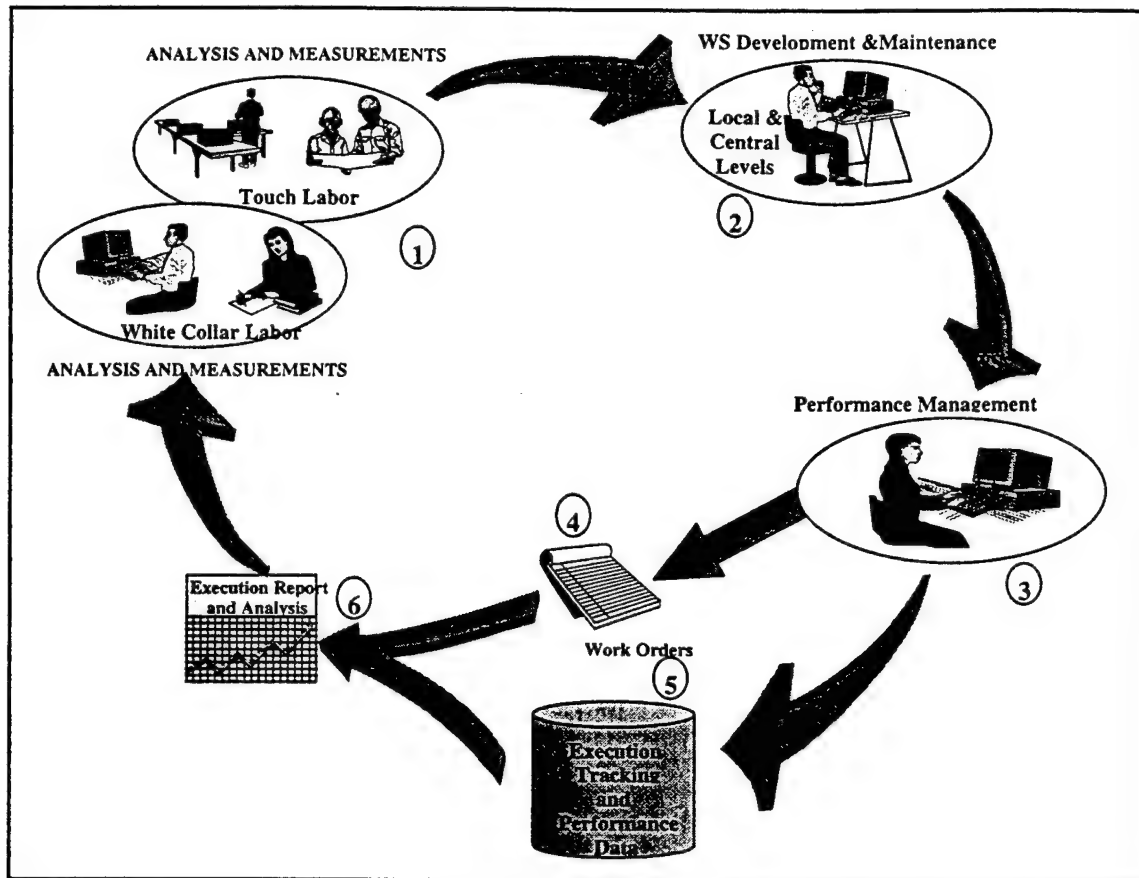
Figure 9: Work Measurement Information Cycle

4.3.2 System Functionality

The WSAP needs to be able to perform certain functions in support of developing and maintaining WS. Functionality is a statement of what the system will be used to accomplish. The functions described in this document are broad, general capabilities which the system will need to provide.

4.3.2.1 For Work Processes

In describing the <u>work processes</u> to be analyzed and measured, the system must be able to:

- Identify units of work *(functions, activities, processes, tasks, jobs, methods, motions, procedures and/or flow of work)* to accomplish a workload—both in general and for specific Defense Performance Units (DPUs)

- Identify and measure products/services produced by each unit of work and/or other workload definitions

- Roll-up these units of work properly *(that is, without duplication or loss of component work and their associated factors)*

- Identify workload information

- Associate both historic and projected performance data (products/services produced along with time and manpower resources used in producing these results) with these units of work in order to conduct analysis and/or alternative "what if" scenarios in support of deciding the most effective and efficient way to accomplish a workload

- Contribute information to and/or receive information from performance improvement programs/tasks (e.g., MOE, ER, BPR, FPI, ABC, PECI, TQL/M, etc.)

- Maintain and update work breakdown structures (WBS) and unit of work descriptions

- Make available predetermined WBS and descriptions, generic or general WBS and/or results from analysis of similar work, along with the ability to "pick-n-plug" in developing a WBS and description for a particular DPU or project under consideration

- Support execution of work measurement plans

4.3.2.2 For Target Time

Once the units of work and products/services have been determined and described, the measurement/determination of <u>the target time</u> for these units of work needs to be supported. The system must:

- Support the determination and recording of all of the factors in the standard time equation (ST=WT/WC*M+A) for the units of work previously described (both for detailed steps as well as larger, more general units of work, 'touch labor' as well as 'white color' labor, and in general and for specific DPUs)

- Document work flow with cycle time, lapse times, operation time, etc.

- Analyze and perform "what if" scenarios

- Properly roll-up times into larger units of work

- Make available predetermined times, generic/general times and/or times from analysis of similar work

- Provide commonality between the development of time factors and development of manpower factors when the determination of one is related to the determination of the other

- Provide data regarding skills and competencies and other labor/job classifications

- Maintain and update time factors

4.3.2.3 Total Manpower

The system will need to support the determination of the target number of <u>total manpower</u> to accomplish the work load of each unit of work—both in general and for specific DPUs. The WSAP must:

- Record all the types of manpower (military, civilian, contractor, other) required for accomplishing the workload of a unit of work

- Automate operational audits, and other numerous techniques for determining the work components, manpower and time required to perform a process

- Document the results of the numerous techniques and methods used for determining manpower—linking resources to work

- Record various factors of staffing formulas and make the calculations used in determining required manpower

- Identify, develop and maintain standard ratios of direct and in-direct (support) for units of work

- Access generic manpower factors and/or manpower factors from analysis of similar work along with the ability to "pick-n-plug" in applying to particular DPUs

- Establish programmable relationships between units of work, workload and manpower needed

- Properly roll-up manpower factors into higher units of work

- Maintain and update total force manpower factors

4.3.2.4 General Capabilities

The WSAP must also provide the following general capabilities:

- Support for developing service-wide generic WS as well as functional/work center specific WS

- Interface with management systems to provide WBS codes, time factors and total force manpower factors

- Interface with management systems to obtain historic/actual data on units of work as to output and the time and manpower resources expended for that output

- Import/export of WSAP data between/among WSAP systems operating at various sites

- Support alternative source evaluations

4.3.3 System Requirements - In General

4.3.3.1 Explanation

The particular requirements for automated support will be presented in the proposed system architecture (Section 4.4 below). This Section will discuss system requirements in general, the types of system requirements, and specific system requirements where possible.

System requirements:

- Contain specifications of what is needed in a system in order to provide functionality for a system.

- Must be determined prior to constructing the system to ensure the desired functionality is captured.

- Describe what is necessary for the system to operate.

- Define the components and their characteristics (size, quantity, quality, length, speed, etc.).

- Set forth desired outcomes and determine what is necessary to accomplish this outcome.

There are three basic types of requirements: information, data and technology. Each of these requirements corresponds to an aspect of the system architecture.

They are stated in broad, general terms at the beginning of design and become progressively more detailed as the design progresses until finally becoming the production specifications for a system. The general, high level system requirements discussed in this document allows decisions to be made regarding the kind of system desired (if any) before expending effort and resources to develop more detailed requirements.

4.3.3.2 Information Requirements

WSAP Information Requirements specify the information required by the users in developing and maintaining WS. This includes such things as what information needs to be entered, accessed, retrieved, and produced (reported/shared). Information requirements specify how the information will be presented—the format of screens and reports (both electronic and hard copy). They specify how that information needs to be processed—the transactions and queries to be supported, and the order of information flow, etc.

The information requirements will be developed for, but not limited to:

- Defining units of work, time factors and total manpower factors according to the normal steps in their development

- "Smart" ("pick-n- plug") modules for the development of WS

- Addressing both standard data and generic (process) WS as well as DPU specific WS

- For recording and processing data from the various techniques used in analyzing work processes and developing WS

- The recording and use of actual performance data

- "What if" and simulation scenarios

- Formatting and presenting WS and linking these factors with management systems

- Utilizing English input and output (not codes)

- (Codes, if used, will be used only in physical programming, not logical designs. Thus any codes used will be transparent to the user who enters or reads the data in English values.)

4.3.3.3 Data Requirements

WSAP Data Requirements will specify the data needed to support the information requirements for developing and maintaining WS. The data requirements will state the data classes, data entities, data elements and the rules for their relationships. These are usually expressed by a data model. Depending upon the techniques used in defining the data of a system, objects may also be identified and described. These requirements will further state the characteristics of these entities, elements and objects, such as domains, range of values, format, etc. Because electronic management of data is based on mathematical logic, data requirements must be stated and managed logically. Then these logical requirements can then be translated into whatever physical format is necessary for implementation.

For the development and maintenance of WS, <u>data requirements</u> will be developed for but not limited to:

- Historic and current data
- General and specific data
- Textual as well as numeric data
- Classes, entities, elements
- Relationships between elements
- Uniquely identifying each data element value

4.3.3.4 Technology Requirements

WSAP technology requirements will specify the requirements for the physical and technological components needed to support the information and data requirements. The technology requirements describe how the data will be physically collected, stored, processed, and made available to users. These requirements describe the hardware that will be needed and used to collect, store, process, and distribute data for users. These requirements also discuss the connectivity and communication needed among the physical components.

For the development and maintenance of WS, <u>general technology requirements</u> will be developed for, but not limited to:

- Physical structure of the data (physical data models)
- Databases (local, central, distributed, warehoused)
- Applications and their locations
- Management plan for data and its processing
- Links with management systems
- Size and speed needed in the system
- Various hardware components and their locations
- Connections and communication between the various components
- User and system software packages

The WSAP will be developed under a client/server architecture. This will allow decentralization of PEs accessing a centralized database.

4.4 Proposed WSAP System Architecture

4.4.1 Introduction

The proposed WSAP is a generic concept for a composite system which is designed to address the general requirements for integrating automated support when developing WS. The WSAP could be implemented in several ways, at various locations and in incremental stages. This document focuses more on general functionality, requirements, types of components and their interrelationship rather than with the technical content and implementation of the design. Even though the term WSAP connotes a single system, in reality it refers to a compilation of functional requirements and relationships contained in various applications, databases and technology components—a "package." Thus it is basically a "system" of various components organized together to operate as a single, more complex system.

The proposed architecture for the WSAP involves three major components:

- A front-end suite of work analysis and measurement tools

- A central site work standard measurement development system containing standard data, common WS and work standard development software

- A local site work standard development system and local WS/data

The following sections describe each of the components, including the functional requirements, high level information requirements, data requirements, and technology requirements. Finally the links within the system and the interfaces with other systems are defined and the communication requirements that will make the connectivity work are discussed.

> *(While the basic computer architecture for the proposed WSAP will be a client/server architecture [to be discussed in Section 4.4.6], keep in mind that each site [i.e., a central site or a local site] will be a client/server situation. In the discussion of components, "central" means a major centralized concentration of PE personnel and services—not a "central server." Similarly, a "local" component is a local site of PE personnel and services, such as an installation or work center—not a "client" to the "central server." Having made that distinction, a server for any site LAN may, in the physical/technology architecture, also function as a server for a WAN.)*

4.4.2 Major System Components

The WSAP is comprised of three major components. (See Figures 5, 7, and 9)

4.4.2.1 Analysis and Measurement Tools

The **first component** of the WSAP design is a collection of a suite of tools which support the use of various techniques for describing and analyzing units of work and which support the measurement of time *and* manpower required to accomplish a given unit of work.

4.4.2.2 Central Site WS Development System

The **second component** is a Central Site WSAP System consisting of a central server with a warehouse of standard data and common (re-usable) WS. This central site server will also house the basic work standard development tool along with some of the front end work analysis and measurement tools. These data and tools can be used by both the centralized PE service and the PEs at local DPUs—i.e., work centers, in developing WS.

4.4.2.3 Local Site WS Development System

The **third component** of the WSAP design is the Local Site WS Development System consisting of a server for the basic work standard development tool which houses standard data and WS which are applicable to the local DPU. It will also provide tools (both front end measurement tools and work standard development applications) either by means of accessing the central site server and/or by having tools reside at the local site server.

4.4.3 Component Functionality Requirements

4.4.3.1 Analysis and Measurement Tools

The first step in developing and maintaining WS is to describe and analyze the units of work (functions, tasks, jobs, procedures, etc.) for which WS are to be developed. The identification of specific and unique units of work is fundamental since WS are developed for a unit of work. The analysis involves:

- Breaking down the work into its component parts WBS of units of work

- Documenting the data associated with each unit of work

- Analyzing the work processes to identify areas for improvement, using process analysis, economic analysis, work flow analysis, variance analysis, staffing analysis, etc.

- Workload forecasting

Once the units of work have been identified, they are measured for the time *and* the manpower needed to accomplish the work. These measurements and related data are documented for use in developing time factors and total manpower factors.

The WSAP will be capable of supporting methods and techniques that perform work analysis and measurement. The basic techniques are described by Mundel in "Motion and Time Study" (7th edition). A list and description of these techniques are found in Appendix D) This functionality will be provided mainly through the a suite of software applications and tools. A wide variety of supporting software available is in the form of commercial off the shelf (COTS) and government off the shelf (GOTS) software. (These tools are listed, evaluated and cross referenced to these techniques in Appendix E.) The centralized PE

support personnel will provide guidance in selecting such tools and for educating/training people in appropriate use of the tools.

Ideally, the WBS (with descriptions of the unit of work) and related time and manpower data would feed directly into the work standard development tool and database(s). But the differences in work unit identification, data naming, and software programs among the tools do not make this capability feasible at this time. Where such tools (e.g., work time, work sampling, and product count tools) do provide direct, automated support to the work standard development tool(s), these automated technique tools would have top priority for use. Later system designs and implementation should include full front-end functionality as an integral part of the system.

4.4.3.2 Central WS Development System

Since a DoD central PE service center is not desired, each Service/Agency will provide a central repository of PE skills and support. This central repository would make available the work analysis and measurement tools as a library of software packages accessed via a central server for on-line use or for down loading.

Fundamental to the quick and value-added development of WS is the electronic availability of standard (predetermined) time data and standard manpower data. A central repository would provide standard time and manpower data along with common (re-usable)WS developed by other DoD work centers. This data would be available to local DPUs either on-line or for down loading. This ability to access and share standard data and common WS allows local DPUs to develop their own standards faster and cheaper. Depending on competition factors, these new WS could be shared with other DPUs by request or provided to a central area for unrestricted access.

The central repository would also maintain a "Work Standard (WS) Builder".

> "The WS Builder" refers to the proposed work standard development tool. The WS Builder would be a single application similar to the "Resource Planner" which is being used by the Navy. The WS Builder would be based on a general core application for development of WS. The general application would make use of various "smart applications." A "smart application" (similar to an "expert module" used by the "Resource Planner") is a subject area focused sub-application linked to related database set(s) which allow PEs to use a "pick and plug" technique or to enter information directly, on-line, when developing WS. The WS Builder would include data sets of general standard data, of different subject matter specific standard data, and of various WS as they are developed. Therefore, it is a basic work standard development tool which conceptually has unlimited expansion capability—"smart application" by "smart application," data set by data set. Front end tools could be added as required. The WS Builder would be designed to support the development of Total Manpower Factors as well as Time Factors of WS for "white collar" as well as "touch labor" work, and of WS for indirect/support work as well as direct work.

The central repository would obtain/develop the specific subject area "smart application" modules for use in the WS Builder. These modules would support both the development of Time Factors as well as Total Manpower Factors (staffing needs). Particularly for the development of Total Manpower Factors, modules would need to contain the capability to

record, store, and maintain data, formulas and algorithms for calculating programmable manpower factors. This tool (including the application modules and data sets) would be available to local centers either by direct on-line access or by down-loading to the local server.

WS developed by a local DPU but which may have applicability to other DPUs could be stored on the Central Server as common or re-usable WS.

When the central PE staff assists local DPUs in the development of WS or develops WS on behalf of the DPU (such as total manpower factors), they can access the central server to support this effort. The total manpower factors would be stored and maintained on the central server and made available to both local DPUs and to HQ personnel and manpower systems.

4.4.3.3 Local WS Development System

WS are developed by and for a local DPU. They only develop standards which are applicable to the work performed at their center. These standards may be developed by applying a standard time or a standard manpower factor, or adapting a common work standard developed by another DPU. This work will be supported with a local server which either houses a copy of the WS Builder along with related "smart applications" and related data sets of standard data/common WS or which provides direct access to them on the central server. The local server will support the storage and maintenance of the DPU's WS.

Since the purpose of the WS is to support management in planning for, controlling, and assessing performance, the local WSAP needs to supply managers with the work standard data in an accurate, reliable and timely fashion.

(The discussion of system components above as well as the discussion of information requirements and flow below are illustrated in Figure 11 - Process, Information, and System Relationships.)
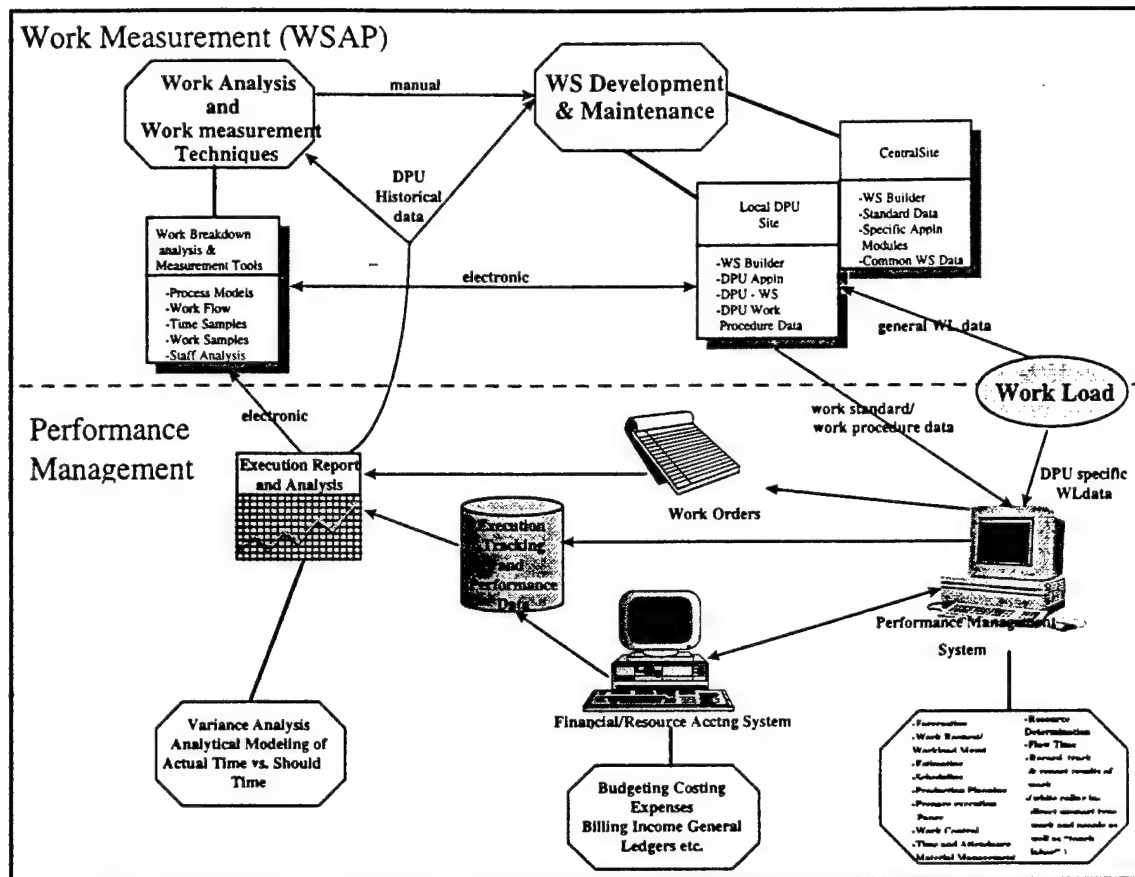
Figure 10: Process, Information, and System Relationships

4.4.4 Information Requirements

The IDEF0 model for *Manage Performance (Support)* provides a design of the overall information requirements and flow.

Beginning with the front-end analysis and measurement of work units, the basic information requirement is to identify, describe and record discrete units of work from the 8th order of work units to the 1st order of work units (see Marvin E. Mundel's book "Motion and Time Study, Improving Productivity" p. 103). In addition, the relationship (structure) between the units of work will be captured and maintained so that the work units and their data can be rolled up, broken down, and/or networked.

Information captured for each unit of work may include, but not limited to:

- Information pertaining to instructions
- Process sheet
- Equipment involved (both as object of the work and as tools to be used to do the work)
- Operating procedures and working conditions
- Workload
- Variances

- Ratios

- Organizational level

- Time Standards -- time required to perform the work (from seconds to months)

- Manpower (numbers and types) needed

- Skills

- Products/services produced

- Costs

- Line balancing

- Work-place layout diagrams

- Work process flow diagrams

Some examples of this are information on time:

- Run time

- Cycle time

- Lapse time

- Job time

- Historical time

- Measured time

- Estimated time

- Average time

- Ranges of time

- Man-hours

It is envisioned that information will be required to support the time standard formula as well as the staffing formulas/algorithms. The data captured will depend upon the type of questions required in analyzing the work. The system will have a query capability to support this analysis and will also be able to produce the appropriate reports.

In addition, it is envisioned that the system will be able to calculate and display data in charts and graphs, calculate percentages, compare various factors and produce work-flow analysis, identify "bottlenecks," perform cost comparisons, and analyze alternative scenarios. Information for ABC (historic and futuristic) will be captured and available for analysis.

The system, as projected, will store historical information on performance—i.e., estimates, schedules, work instructions ("work orders"), and budgets, along with actual time, manpower, and costs of products and services produced to support variance analysis as well as other aspects of work analysis and measurement. Comparison of WS—both time and manpower—will require actual performance data in order to confirm the validity of WS. Therefore historical (actual) performance data from local level

management systems will flow into the work analysis system—either manually or electronically.

(Since none of the requirements for the WSAP have been documented or approved by users, the use of the word "will" is for tense purposes, not as a "command" or "insistence". The use of the word "will" is to describe a desired, projected or envisioned system -- "the envisioned system will be able to do xxxxxxx.")

Basic information about a unit of work, (i.e., the name, description, time(s), manpower needs/formulas, related item(s) of material, etc.), will be transferred, either through "picking-n-plugging" items from the "smart applications" or on-line data entry, to the WS Builder. Then based on this information the WS for a particular work center/project can be developed. Specific to the development of Total Manpower Factors, the WS Builder will need to capture and calculate information relative to staffing algorithms, workload, and time. The WS Builder transactions will support the development of both time and manpower standards at any level of work detail that is appropriate for the management of the work under consideration. It will also support the roll-up, breakdown and networking of various combinations of units of work.

Access to the WS Builder database will be available via pre-packaged "smart applications" and general search queries. Information requested will include standard time and manpower data both in general and by specific subject and WS developed for similar work. The system will assist the developer in developing particular standards and combining them into work packages for jobs, tasks, up to and including the total work center project. This will include transaction modules for simulating and developing routings, determining critical paths, and calculating estimates on time, manpower and costing.

Once WS are developed, the system will provide the ability to update these standards, either selectively or in mass. Updates to WS will be managed by the security systems of the local and central repository systems.

Both logically and from the information user's point of view, there is only one WS Builder and only one set of standard data, common WS and local WS—available (as permitted) both at the central WSAP and at the local WSAP. But physically, as shown in the technology requirements (Section 4.4.6), this may not necessarily be the case.

Though developed for the local work center, total manpower factors are mainly used by higher levels of management, particularly headquarters (HQ) levels, for determining yearly, workload specific manpower requirements. These requirements are submitted to the appropriate authority for manpower and funding authorization and/or to design end-strength, force structures, manpower programs, etc. Therefore information regarding work and related manpower must be shared with service-wide personnel and resource management systems. As the development of manpower factors is often related to workload data (either in general or specifically), work load information from higher levels of management flows into the development of total manpower factors.

> *(The <u>distinction</u> between total <u>manpower factors</u> [e.g., staffing standards, staffing models, staffing needs, labor demands, etc.] and <u>manpower resource requirements/requests</u> [e.g., "the Answers" which are determined*

by management applying manpower factors to specific work loads and which are submitted by managers as their official resource request/requirement] must be maintained. WSAP supports the development of manpower factors but does not determine or produce the official manpower resource requirements/requests. The former is the work of PEs. The latter is the work of high level managers such as installation or MAJCOM commanders. In fact the WSAP does not provide for the development of any resource requirements or requests. Resource requirements are developed by managers, personnel and finance people. The WSAP does provide data to assist managers in developing resource requirements/requests. For example, in the Army's 12-Step Process , step 6 develops the total manpower factor based on the work analysis of steps 4 and 5. Steps 7-12 determine the manpower requirements/request which are done by management with assistance from manpower/management analysts.)

Time factors, on the other hand, are mainly used at work centers for estimating, planning, scheduling, costing, and controlling local work loads and assessing local performance. Therefore information regarding work and related time factors is made accessible to the local performance management system(s). Because time factors are developed with local workloads in mind, information on local workloads needs to be accessible to the developers of time factors.

The system will support multiple queries and requests for on-line "reports"—both preset and user-defined. The types of queries and reports produced will be determined by requests inputted into the system by the users.

4.4.5 Data Requirements

Data requirements are the data entities and elements (attributes) which are used to support the information needs of the users. The data requirements state the logical relationships of the data entities and elements, along with the definitions and various characteristics of the entities and elements. In addition, the data requirements discuss the business rules governing the data. Requirements are expressed in logical relational models and sometimes documented in object oriented models. The objective of the models is to insure the integrity, reliability, shareability, accessibility and extendibility of the data. The ultimate goal is for data to be captured and stored once and then used many times whenever and wherever it is needed. The more rigorous the logical model the easier it is to build and maintain a reliable information system which easily shares data.. The quality of an object oriented model depends upon the quality of a prior relational data model.

At this general level it is not necessary to identify data requirements; nor is it really possible to identify them since particular information requirements have not yet been identified.

At this general level it is possible to identify some data classes—general subject areas of data. Several data classes for work measurement/WS are listed here and need to be included in the WSAP.

- Work data (name, WBS Number/Task Code, description)

- Time data (job time, lapse time, cycle time, total man-hours, etc.)

- Manpower data (position types, skills, occupation categories, occupational standards, ratios, number of manpower needed for work (job) per time-period, direct requirements, support/office structure etc.)

- Materiel data (end items, parts, repairable, equipment required, etc.)

- Work conditions

- Unit-of- work interrelationships (WBS, network, critical path, PERT data, etc.)

- Output data (products, services, output (performance) measures and count)

- Workload data

- DPU data (name, organization, location, etc.;

- Methods of determination/measurement (Work Standard audit trail)

- Work Standard (heading, dates, by whom, packages, identifier, etc.)

4.4.6 Technology Requirements

A system's technology architecture is a design of all the physical components, along with their relationships and requirements, that are necessary to implement the system. The major sub-systems of the technology architecture are data storage and management, computer hardware, communication technology, and the applications which process and manage the data and the systems.

Technology requirements cannot be fully explored until other requirements are defined. Transaction requirements and logical data design are necessary for determining data storage and management requirements as well as application requirements. First the volume and accessibility of data, the number of users and their needs, the distribution of users, the distribution of data, the speed of transactions, etc. must be decided before the other technology requirements can be identified and designed.

This high level system architecture contains only a discussion of very general technology requirements and a conceptual design. (See Figure 11 - Technology Design for a diagram of the general technology design.)
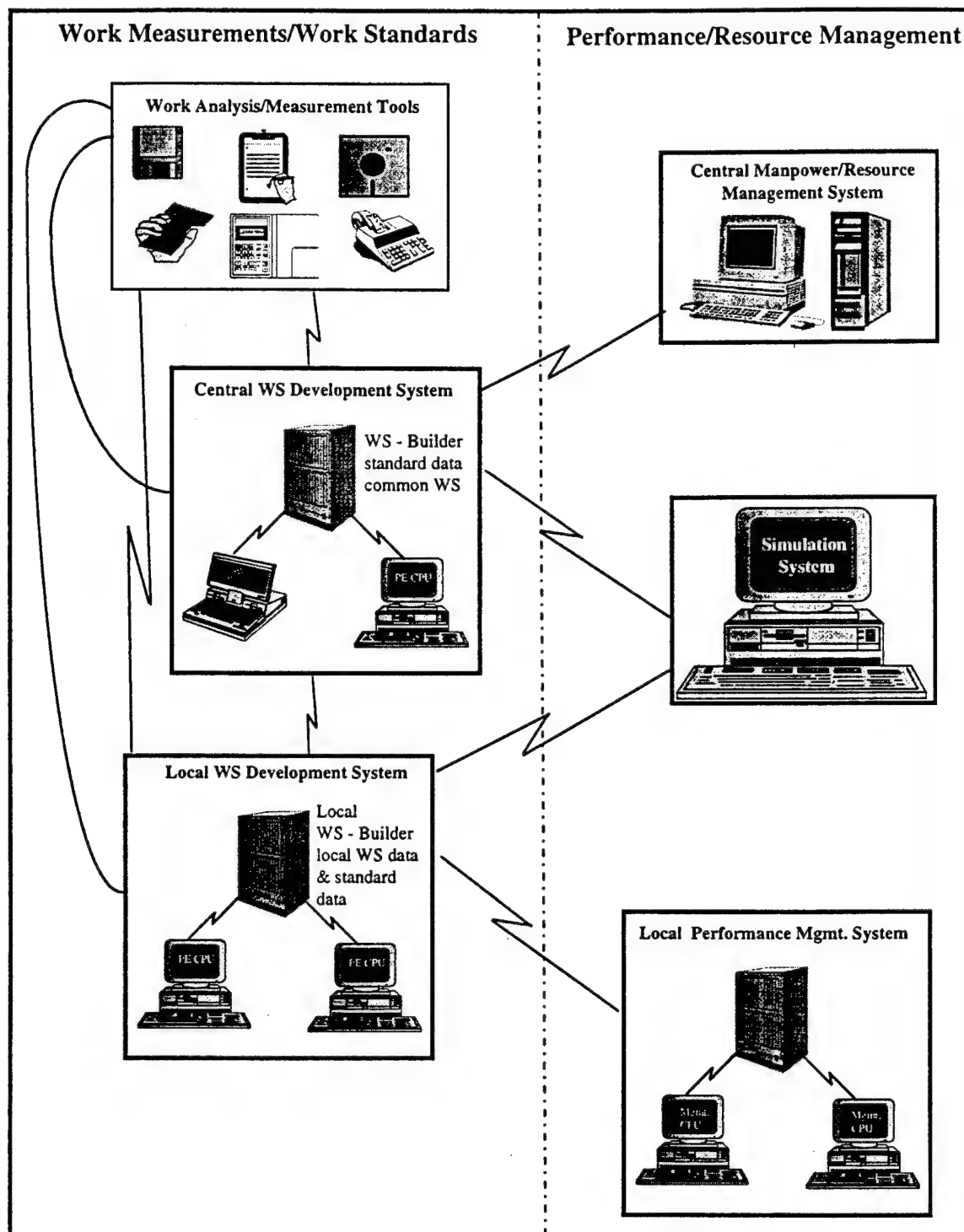
Figure 11: Technology Design

The basic technology architecture will be a client/server architecture. This architecture will support the WSAP for:

- A single user running the client(s) and server(s) on a single box

- Multiple networked users running the client software locally and the server software on a different system on the same network

- Multiple networked users running the client software at local node/unit and the server software on a different system on a different network

The proposed WSAP architecture envisions a server at each site. *(Technically, it is possible for more than one WSAP site to operate from a single server by means of a wide area network [WAN], though this is not proposed at this time.)* The official WS will be kept on a server (not on a client). But which servers will actually store which data and who has access to that data are requirement issues for a more detailed level of architecture development. Nevertheless, with this general client/server architecture, it will be possible for each WSAP server to know the location of other WSAP servers and the extent/means of sharing the data of each site. Part of the more detail architecture will be determining:

- What is confidential "locally owned" data and which data can be shared (re-used)

- Where the shared data is located

- Who may access this shared data

- How to access it

Now some servers may house more common data and common software than others and thus be considered "central servers." Thus, it is important to distinguish between "central servers" and a "central PE service site." Any "server," technically, can be designated as a "central server."

A central site WSAP will be based on a server and a WS Builder with related databases of standard data for time and manpower along with the WS data that are available for common (re-)use. The number and size of Computer Processing Units (CPUs) related to the central site server will depend upon the number of PEs operating out of the site plus the volume of work to be performed by the centralized site. Because the PEs at a centralized service location will be serving local DPUs, a number of portable CPUs will be required to travel with the PEs. These portable CPUs will require communication links with both the central site server as well as the local site server. The number and location of such centralized sites will depend upon how the centralized management of DoD WS is organized, e.g., by services, by functionality, by time factors vs. total manpower factors, by geography or by some combination of these.

The other basic component of the WSAP will be the local work standard development sites. Each site will have a local server connected to CPUs for local PEs. The size and configuration of these local sites will depend upon:

- Whether they will be using the WS Builder on-line (connected to the central site server) or accessing a local "copy" of the WS Builder

- The volume of WS to be developed and managed at a local site

- The number of PEs operating at the local site

Because the PEs will be visiting the local work sites, managers and supervisors, they will need portable CPUs with communication links to the local site server (and possibly to the central site server as well). If electronic measuring devices are being used by the local PEs, these will require electronic links to the local site server.

Automated work analysis and/or measurement tools will be available to PEs either through the servers and/or individual CPUs. Where possible, these tools will be programmed to interchange data directly with the WS Builder.

4.4.7 Connectivity

The centralized work standard sites will need to be linked to central (HQ level) personnel and resource management systems—both to send and receive appropriate work standard data and appropriate historical performance data. In addition, the local work standard sites will require links to local performance management systems—both to send appropriate work standard data and to receive appropriate historical performance data. Both the centralized and local work standard sites will require links to various simulation tools being used by their respective services and functions as well as any joint service simulation models.

4.4.7.1 General

As part of the processing cycle for work measurements and standards development, adequate interfaces and linkages between the mechanical systems must be in place to support these functions. The WSAP will contain the capabilities to support the requirements for capturing, measuring and analyzing work measurement data at a local level and upload this data to the local management system. As depicted in Figure 12 - System Interfaces below, these functional requirements are addressed by the PE systems, the Performance Management systems and tools currently in place.

In order for work measurement data to be managed successfully adequate automation must be available. Therefore, the WSAP will automate techniques for recording work measurement data from touch labor and white collar labor (for staffing) performance. The WSAP will also analyze and measure the work and develop WS which will be shared with the Performance Management systems. The Performance Management systems will then use this data for local management functions and will relay actual performance data to the PE environment. This is currently done manually, but under the WSAP, the electronic transfer of this information will be encouraged.
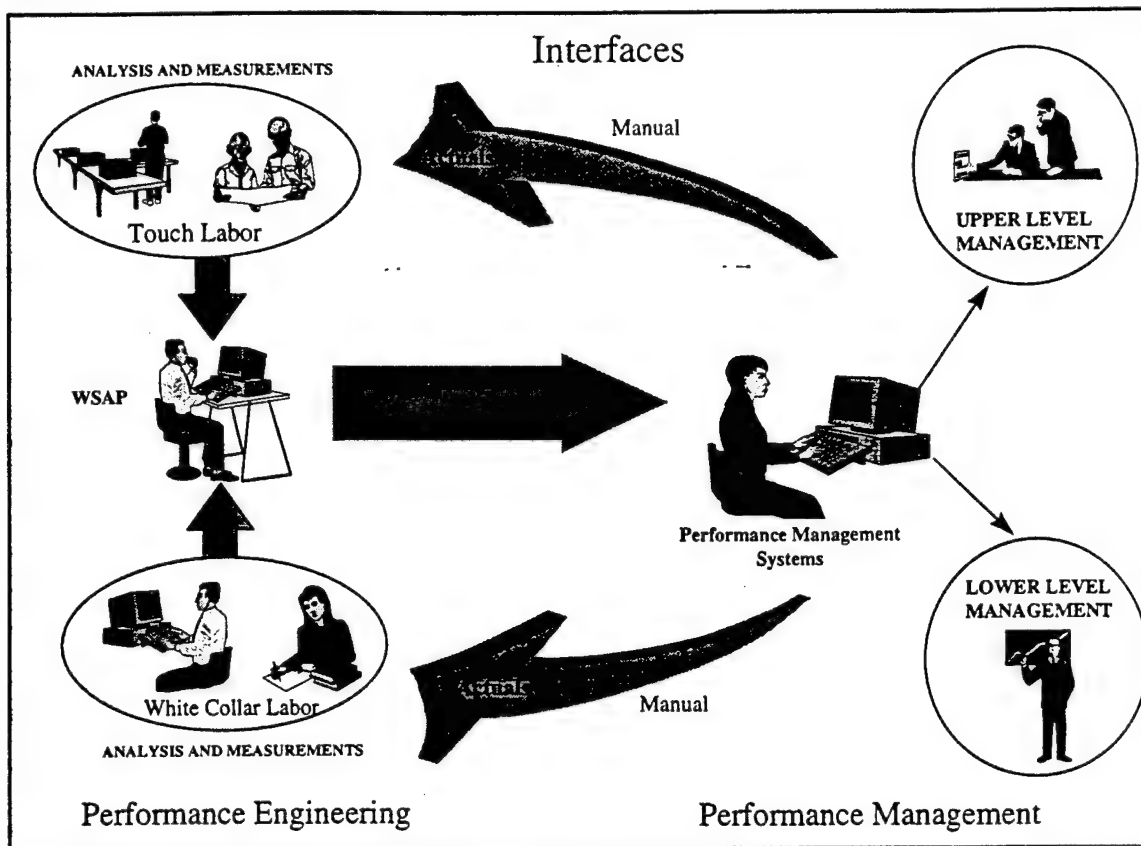
Figure 12: System Interfaces

A copy of WSAP will be downloaded from the central site and tailored to meet the needs of the local DPU. This is similar to the capabilities that exist in the Navy's Resource Planner. Since there will be common data and functions, an on-line connection will be necessary for both local and central versions of the WSAP. Depending on the needs of the sites (different functional and business areas), there could be a requirement for several different central locations for the WSAP. Therefore, connections to all other central sites will be necessary. So far it appears that the existing communications and connectivity can handle integrating the different sites of WSAP. However, if the configuration requirements change, the new requirements will need to be identified in the technical requirements. Figure 13 - System Connectivity and Interfaces illustrates the interface requirements for the local and central WSAP and management systems.

The connectivity and interfaces between these systems is crucial to the overall success of work measurement/labor standard processing. The information recorded and analyzed by the local engineering systems will provide important information to the local management systems. This information is required for managers to make planning decisions and important projections.
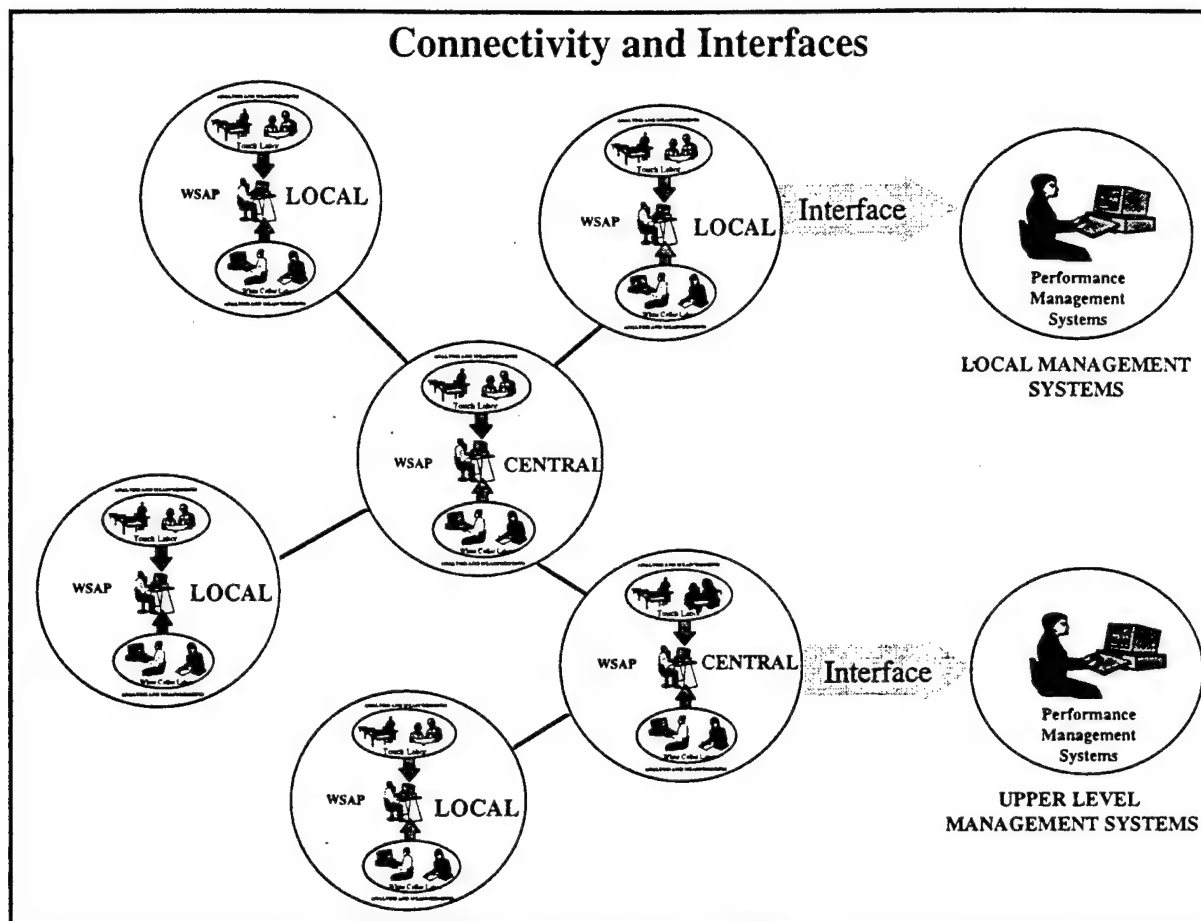
Figure 13: System Connectivity/Interface

With the use of several different techniques such as data standardization, EDI formatting, and communication upgrades, system integration and connectivity can be improved. DISA has provided several methods and standards that implement these techniques to produce standard data and systems. This support is structured to ensure that requirements are gathered, complied and well managed to meet Service needs. These requirements, functional data and applications (developed by the D7 requirements integration methodology process), for integration against the DISA major focus programs, such as Global Combat Support Systems (GCSS), GCCS, Defense Information Systems Network (DISN), Electronic Commerce/Electronic Data Interchange (EC/EDI), DMS, and INFOSEC, are there to ensure reusability and connectivity.

4.4.7.2 DISA Standards

One of the main standards DISA has provided for system development is the Defense Information Infrastructure Common Operating Environment (DII COE). The DII COE was directed and produced under the guidelines of the Technical Architecture for Information Management (TAFIM). The goal of the DII COE is to ensure that applications with a common look and feel execute and run in the same environment. As part of the Technical Reference Model (TRM) of the TAFIM, the DII COE has a technical base of both data and application components that are platform independent. Therefore, they provide the

openness that is beneficial to system development today. For this reason, the DII COE infrastructure can be used to support a client/server design with the use of DMS, EDI, etc.

4.4.7.3 Potential Connectivity (GCSS & DISN)

A possibility to make WSAP capabilities available across the Services would be to link into, as a component, a system like the GCSS. This system includes multiple workstations connected to a distributed LAN/WAN environment and can provide cross functional access and capabilities on a single local workstation platform. It provides cross functional integration, with key features such as push/pull data exchange, data process, and the communication structure. GCSS includes mission applications from a variety of other programs operating in a "federated" mode. "Federated Mode" means that the application is constructed so it can run on the same hardware without interfering with other software but unable to share data between applications.

GCSS uses the TRM which is described in the TAFIM, Volume 2. This model fosters a transition from legacy applications to a distributed computing environment. The goal of the TAFIM is to serve as a generic framework for developing, not implementing architectures. For example, not all of the service areas in the TAFIM will be required and therefore will not be populated with data. The GCSS program has incorporated this tailoring concept into its design.

Even if the WSAP is not incorporated into an already existing DISA program (or project) like the GCSS, it still needs to provide the basic capabilities to meet the DII COE communication requirements. To accomplish this, several communication issues must be addressed . The communications issues involve both support for internal and external data transfer as well as component structures for implementing a distributed processing environment. WSAP configuration must be supported by local networks and able to connect to already existing network structures like the DISA's DISN. It must provide distributed computing services and specialized support for applications that may be dispersed among computer systems (both local and central, internal and external, PE and Performance Management type systems) in the network, but must maintain a cooperative processing environment.

4.4.7.4 Data Connectivity

In order to obtain this level of open connectivity, emphasis must be placed on sharing data among systems and automation tools. It is easier to address this data issue than to have links into every PE and Performance Management system. The connectivity of these systems will rely heavily on the capability to share data among themselves rather than be part of a standard physical operating system. DISA standards provide the support for this connectivity.

4.4.7.4.1 DII COE Standard

One of the key characteristics of the DISA system development standard is that a data interchange service should be provided by the DII COE compliant system. This service is designed to handle data interchanges between applications on the same platform and applications on heterogeneous platforms.

The DII COE is a standard that will allow properly designed applications to coexist and operate in the same environment. However, simple coexistence is not enough,

applications must be able to share data. The DII COE addresses this requirement by setting up mission applications to share data at the server level.

The standard dictates that data be at the server level (more central) versus dependent on the application and be accessible by the applications. This concept is important to the implementation of the functional requirements of the WSAP. Since it is not feasible to create a monolithic type system where application and data are all interdependent, attention must be focused on connecting the data.

4.4.7.4.2 EDI Standard

This data interchange can be facilitated by using the standard DISA Electronic Data Interchange (EDI) formats. By using EDI formats to communicate data to the various systems and levels of command, it provides the pathways and opens channels of data necessary to support several different PE and Performance Management systems.

Additionally, EDI addresses the COE standard which requires the use of formatting standards by successfully providing formatting standards capability for transferring information between active DoD Systems. The standard provides accessible and visible data necessary to facilitate the rolling of data between WSAP work measurement and standard development and management processes.

It is critical for the data to be in the same format for the purpose of linking information within the current business areas as well as across other business areas. In order to roll up and link information across several systems, there has to be data commonality, otherwise it is a comparison between "apples and oranges". EDI formatting techniques and transactions layouts can provide data commonality. More specifically, this formatting standard could be used for communicating information design, invoices and budget information—already translated into preset transaction formats for standard data elements. Additionally, using format standards would ensure the integrity and the validity of the data.

4.4.7.4.3 Data Design

In a more technical discussion of a system architecture, logical and physical database schema designs would be developed. The WSAP presented here is a generic system architecture and more of the features will be addressed in the database schema. These features would include entities within this system and the relationship(s) between them. All elements that must be stored and maintained will be identified, along with the type of data and how the data are associated with each other through usage and requirements for direct mapping (to maintain the characteristics of a purple environment).

It is essential to determine not only the availability and formatting of data, but to also determine the visibility of the data. As a whole, the pertinent data elements need to be determined, standardized, classified, typed, and stored. As a result, the level of visibility these data elements should have, either upwards or downwards, will be determined.

4.4.7.5 Trade-Offs

When dealing with a distributed type environment of two separate locations (local/central), some trade-offs occur involving security, portability, and performance. These

communication and connection issues need to be addressed in a more technical version of this document.

4.4.8 Future Innovations

Some of the suggestions for the design of the WSAP were more ambitious than could feasibly be included in this design. They will be addressed in future documents. However, below is a list of suggestions for the next round of improvements:

- Standardize work (WBS, unit of work), time and staffing terminology within and across DoD Components so that cross analysis and communication is possible

- Increase connectivity and joint development of systems for work, time and staffing measurement and standards development and for sharing of work measurement and work standard information

- Interactive visual capability for defining processes

- Voice Activated systems

- Seamless interactive program from work/process description through to work standard, including technical manuals, drawings, mission/function/task requirements (e.g., ROC/POE), and directive staff requirements

4.5 Implementation Approaches

4.5.1 Introduction

Normally, automated system implementation alternatives present various combinations of system requirements including software and hardware. The different combinations are evaluated for functionality, cost, time to implement, feasibility of implementation, etc. so that the customer can determine the best value.

Since the WSAP is not replacing an existing system nor is it being designed to address an existing workload, this report does not discuss the specific values of system requirements (i.e., volume of transactions and data, frequency, speed, storage space, site number, location and linkage, number of users, etc.). Without such system requirements data, it is not possible at this time to discuss software, hardware, and other technology which are determined and evaluated in terms of such system requirements data.

Instead this Section focuses on a discussion of conceptual approaches for implementing the WSAP within DoD. Below are several possible approaches for implementing the WSAP. *(Unless decided otherwise, all the alternatives depend on using WSAP to support the development of both time factors and manpower factors.)*

4.5.2 Total Turn-Key

The "total turn- key" approach would be to design and build the WSAP as a single, integrated system to provide all DoD components and agencies with work standard development support at the basic local level. All components (front-end, central systems and local systems) would be developed together and implemented simultaneously across all of DoD and would be fully operational ("turn the key and go") upon installation. However, installation may be phased in over an established length of time.

4.5.3 Limited Turn-Key

The "limited turn-key" approach would be to design and build a single WSAP for one DoD component or DoD-wide function. All components (front end, central systems and local systems) would be developed together, and implemented simultaneously across all of the selected DoD component. They would be fully operational ("turn the key and go") upon installation. This approach is similar to the "total turn-key" approach, however it would be limited to only one DoD component or major function. This system could then be replicated to other components as desired.

4.5.4 Modular Expansion (with common blueprint)

The "modular expansion" approach would begin with a group of SMEs knowledgeable in process improvement, labor standard development and staffing standards development who would design implementation (production "blueprint") requirements for a WSAP. This blueprint would describe the production specifications for information, data, and technology requirements of the WSAP. The focus of this design would be the WS Builder which could be modeled after Navy's Resource Planner. A prototype of the WS Builder would be developed and tested. It would include existing "expert modules/smart applications," sets of standard data and existing WS. If additional basic "smart applications" were deemed necessary, they would be designed and built (or purchased).

This "blueprint" would establish standards for data, software, hardware and communications for integrating and sharing data. This design, while considering requirements for interfacing with performance management systems and with front-end analysis and measurement tools, would not address requirements those interfaces. The design would address interfaces with existing work standard systems and the migration of these WS into the WSAP.

DoD services and/or particular local centers (such as installations or particular work centers) would acquire a copy of the WS Builder "Blueprint" and prototype. Based upon this common design and prototype, they would develop a local WSAP system to meet their needs. In addition, a DoD service or a Joint Services function could use this design and The WS Builder to establish a central WSAP system to support and coordinate the work of two or more local WSAP systems. The local WSAP system may have its own copy of the WS Builder or may access a copy through the central server. The same would be true for the WS data. Either local or central sites would develop additional "smart applications" as needed for particular subject areas of work not covered by existing "smart applications". A DoD-wide resource library of "smart applications" could be developed for use by WSAP sites. Connectivity and interchanges between WS development systems would be established as needed. As a result, the size and complexity of the WSAP would grow (both at a particular site and across DoD) as the need for its use increased.

Thus the development and use of the WSAP would be implemented at each location on an "as needed" basis once the need for WS development support has been recognized and funded by local and/or central management. However, realistically these WSAP systems will probably be implemented at locations based on the speed with which DPES can "market" them.

Each WSAP site (both central and local) would be responsible for developing the necessary interfaces with local and central performance management systems. Inter-connectivity between the locations (servers) using the WS Builder will be developed as the

requirement for sharing WS and standard data arises. Over time, this growing inter-connecting web will link all DoD WS development systems into a single DoD-wide system.

Front-end automated work analysis and measurement systems will be added by local or central systems as requirements and technologies develop. This capability will be added to the "library of tools" for use by DPES and will be a shared resource across the network of PE support.

Existing labor and staffing standards will be located and managed at a particular site (either local for labor standards or central for staffing standards). These sites will be responsible for the migration of the legacy WS (and related data) to the WSAP when it is established at their site.

Rather than building a central standard system and mandating its installation and use by all sites, this approach builds a common design (blueprint) which can be implemented by any location as needed, as funding is earmarked for this task and as the personnel are available to install and manage it. Since the WSAP is composed of modules—both as site locations within a larger, expanding WS network and as "smart applications" within a local WSAP—it is very flexible and expandable and will have very little impact on existing functionality and operation.

4.5.5 "Economy Model"

The "economy" approach is a variation of the "Modular Migration" approach. First a team of SMEs knowledgeable in process improvement, labor standard development and manpower factor development would quickly refine the functionality and system architecture requirements to the next level of detail. Then they would select the "best of breed" commercial automated work standard development tool which most adequately provides the defined functionality and most adequately supports the defined system architectural requirements, e.g., similar to the Navy's Resource Planner. (See Appendix E for an evaluation of selected current COTS products as to their support of the defined high level functionality for the WSAP.) Implementing the use of the selected tool across DoD would save development and implementation costs. It would be identified as the primary work development tool and be promoted for use, both as the basis of a local WS development system and for other central WS development centers. The implementation of this tool would follow the "Modular Expansion" plan discussed in Section 4.5.4.

4.5.6 Full Front-End Automated Support

This option involves adding full, comprehensive, front-end automated support for work process analysis, improvement and measurement that is electronically integrated with the WS Builder. It can be added to all of the alternatives above. This would involve a special application and database design effort for each of the tools to be added. Such development and integration would involve determining the nature of current and future automated support, selecting COTS tools which are most compatible with the WS Builder and then customizing them to interface/integrate with the WS Builder. This option would depend upon the establishment and fairly wide use of the WS Builder before it would be determined practical or feasible to implement.

4.5.7 Other Implementation Considerations

4.5.7.1 Identifying and Locating Central Sites

Regardless of which alternative is selected, there are other alternatives which need to be addressed in the implementation of the WS Builder. These alternatives discuss ways to categorize and relate the central sites. Since, at this time, it is not envisioned to have a single DoD central WS development site/repository to serve all local sites, then what kind of central sites would there be? Possible alternative categories for establishing and linking central WS development sites would be:

- By organization, such as one central site per DoD Component or one central site for each major command

- By functional subject matter cross DoD organizations, such as depot maintenance, health service, facility maintenance, financial services, training, food services, HQ operations, etc.

- By some combination of organization and function

- By support of "workload driven" functions vs. support of more "general/overhead" staffing type functions

4.5.7.2 One System or Two?

Another major consideration may also need to be addressed. Is the development and use of Time Factors so different from the development and use of Manpower Factors that it would be better to have separate WSAPs for each? Perhaps it is more helpful to have two separate WS development systems—one focusing on developing Time Factors and one focusing on developing Manpower Factors, each with its own network of local WSAP sites.

4.5.8 Potential Future Alliance—Standard Readiness Indicators

During the research of this project, it was discovered that a special project existed which was in the process of objectifying indicators for readiness by sub-activities (high level work breakdown) on Navy shore installations. With monthly recording of data for these indicators, the readiness status of each sub-activity, activity and installation was calculated and objectively stated each month. These readiness indicators were the results of work analysis and measurement similar to that used in the development of time and manpower factors. Some of the indicators resembled time or manpower "standards" at a high level unit-of-work.

While "readiness" and "readiness indicators" are not part of work measurement and WS, they are a major indicator of performance and a major driver of concern about performance. To be able to objectively project and measure readiness would be a great assist to managers responsible for ensuring the readiness of the armed forces. Also, with objective standards to indicate readiness, comparison and evaluation could be made within and across functions and Services. Furthermore it is a way to objectify and measure performance so that it may be managed more effectively and efficiently.

In terms of work measurement and WS, standard readiness indicators would help standardize work breakdown structures, work naming, and work count. Then, for these common units of work, common (standard) time factors and manpower factors to ensure

readiness could be established. These common time and manpower factors (along with the readiness indicators) could then be used to improve planning, projections, requests, distributions, and daily management (control) of production and services. Linking work standard development with readiness indicators would go a long way in relating WS to a meaningful bottom-line.

To enable this, one approach would be to include in the WSAP design an application and data set(s) for the development and use of "standard readiness indicators". These indicators would be based on the same work analysis and breakdown structure as the time factors and manpower factors. The time and manpower factors for these work units would be in terms of time and manpower needed to maintain a satisfactory readiness level.

While readiness and readiness indicators are not part of the current "business" and design of the WSAP, a future alliance between WS and readiness indicators is a possible avenue of development which could prove mutually enhancing.

5. IMPLEMENTATION ALTERNATIVES

5.1 Introduction

The baseline (As-Is) of WM/LS has been expanded to include manpower standards/models and has been documented as Work Measurement/WS (Section 2). An improved redesign of the "Work Measurement discipline" processes has been proposed as DPES to all the Performance Management processes (Section 3). The development of work standards is one aspect (subset) of DPES. A high level system architecture for automated support in developing and maintaining WS has been designed (Section 4).

The next step in the improvement process is "implementation". Section 4.5 discussed several possible approaches for implementing the WSAP system within DoD. This Section (Section 5) presents several practical alternatives by which DPES (IDEF Model A5) and the automated support (WSAP) of work measurement/work standard development (IDEF Model A5.2) could actually be implemented. These alternatives fall into two categories. One is alternatives for implementing PE support in general (Section 5.2). The other is alternatives for a work standard automation package (Section 5.3). For the work standard automation packages, comparative evaluations and recommendations are presented (Sections 5.4 and 5.5).

These alternatives are presented to assist the project management team and appropriate offices within DoD in determining the next steps for improving PE support for DoD management with the end goal of improving DoD performance—(i.e., providing quality products and services which meet customer requirements at reduced cost).

5.2 General Performance Engineering Alternatives

5.2.1 Introduction

Where there is a definite functional process that involves existing mission, work load, personnel, procedures, organization and management components, improvement alternatives normally involve changes in one or more of these components. When automated support systems are involved, improvement alternatives involve combinations of the new processes along with related system improvements.

This is not the case with Defense PE Support. In DoD there is not a definite functional process that involves existing mission, work load, personnel, procedures, organization and management components for the work measurement discipline. Currently this work is carried out by a variety of personnel, organizations, procedures, etc. Therefore improvement, as discussed and proposed in Section 3, has more to do with changes in the concept, general approach and mode of operation of the work measurement discipline rather than changes in particular processes. These changes fall under the term "PE support".

Because of this situation, implementation involves addressing the nature and degree to which changes will be made in providing PE support. This first set of implementation alternatives address the extent to which DoD will implement and advocate "PE support".

5.2.2 Status Quo

The first alternative is to not make any changes. This approach requires no time or cost to implement and provides a baseline against which all alternatives for change can then be evaluated.

5.2.3 New Policy

One of the major deficiencies in the area of work measurement and work standards is outdated policy. Therefore, writing and issuing of new policy is a basic alternative for enabling improvement in the development and use of work standards in particular and in providing PE support in general.

Such new policy for work measurement/work standards and PE will also provide permission and advocacy for the changes in PE support that are currently underway in "the field."

As the minimal positive step for improvement, this alternative would only write and issue new policy for work measurement/work standards and PE support. It would then be a basis upon which other improvements could be made.

5.2.4 New Policy Plus Sponsor DPES

A more pro-active alternative would not only write and issue new policy, it would also actively sponsor the formation and development of DPES.

A DoD office and staff would sponsor, promote and facilitate the formation of a DPES "program" with specific functionality in DoD components and their organizations. This alternative would provide resources for promoting and facilitating PEs who would design, develop and operate DPES as a recognized assistance to DoD management at all levels. Regardless of the form in which DPES is established, it would be officially sponsored and supported by the DoD and be provided as an official service to DoD managers. While the DoD related office would do whatever necessary to enable and ensure the formation and operation of DPES, it would be the PEs who would be responsible for the actual formation and operation of DPES.

5.2.5 New Policy, Sponsor DPES, Plus a WS Application Package Alternative

This alternative would build on the previous alternative by providing one of the WSAP alternatives presented in Section 5.3. Not only would there be a new DoD Policy and DoD sponsorship of DPES, there would also be a WSAP system to provide common, standardized automated support of work standard development.

5.2.6 Full Performance Management Automated Support

This alternative would build on the previous alternative (Policy, DPES and WSAP) by designing and building an automated information system to support the full range of Performance Management. This alternative actually is an implementation alternative for the DPPI Project, Phase I. However, because the success and effectiveness of PE in general and work measurement/work standards in particular is directly related to the performance management, this alternative also applies to DPPI Phase II. Effective

performance management depends upon a user-friendly automated management support that ties all aspects of performance management together in one automated system. Also, automated support of performance management is the most effective way of implementing and enforcing an improved management approach. This support is critical to implement successfully the improvements developed under GPRA and the NPR. Otherwise, improvements developed under GPRA and NPR cannot be reliably measured and may possibly add paper work for over-burdened managers.

The design and implementation of this system would be an ambitious project requiring major funding and support from DoD and the cooperation and participation of all the major Under Secretaries of DoD. This system would enable managers to "measure performance" and thereby improve performance.

5.3 Specific Work Standard Application Package Alternatives

5.3.1 Introduction

Each WSAP alternative below, except the "Status Quo," is presented as a viable means to provide a DoD standard automated system for the development and maintenance of work standards.

The basic component of each WSAP alternative would be a WS Builder. The WS Builder would be composed of a main application module which would assist a user in developing and managing work standards, and would include capabilities for communication and for packaging and resourcing work. The main application would make use of various standard time data sets and of various "smart applications" (a sub-application and related data set for developing work standards for a specific subject area) to develop work standards for specific types of work. The WS Builder at each site would include any modules needed to service the type(s) of work that the site supports. (See Section 4 for details of functionality and requirements for the WSAP as well as a description of the WS Builder.)

Each alternative will include the establishment and maintenance of a World Wide Web site. This site would allow for sharing information and resources regarding work analysis, work measurement and the development of work standards. It would also include information on current developments within PE both within DoD and the commercial world. These World Wide Web (WWW) pages could be password protected to protect the integrity of the information and prevent unauthorized use.

It is assumed and recommended that the front end component (a suite of work analysis and measurement tools [including support for various motion study and time study techniques]) will be identified, procured and made available by the customer, engineers and/or PE Support Service(s) for each WSAP site. (For a discussion of functionality and requirements of such tools, see Section 4, particularly 4.3.2, 4.4.3.1, 4.4.4, 4.5.6 . For a description of the techniques to be supported, see Appendix D. For a some current COTS tools and an evaluation of their support of WSAP general functional requirements see Appendix E.) Some of these tools may already have the capability to be electronically interfaced/integrated with work standards development tools, such as the projected WS Builder.

This recommendation is based on the fact that a wide range of such tools are currently available from both commercial and government sources. In addition, the requirements for choosing the appropriate tool varies—depending on the work to be measured and who is doing the measuring. Also, such tools are constantly being developed, improved and updated.

The recommendation is further based of the reality that if such tools are to be integrated or interfaced with the WS Builder, this WS Builder must first be developed and the requirements and specifications for such tools and their interface/integration must be documented. Then, based on these documented requirements along with an analysis of the value-added of each "front end" tool, such "front-end" tools could be selected and integrated with the WS Builder. Until such time, these tools can be used as stand-alone tools which provide data for the development of work standards as well as supporting other services provided by DPES. This recommendation is consistent with the approach to provide maximum flexibility and adaptability through establishing standard requirements vice standard physical system. This approach establishes standard requirements (design) and allows the users to select the tools best suited for their needs and to develop a library of tools, rather than imposing a standard "suite of tools" upon all users.

Since this component is a common to all the alternatives, it will not be figured into the comparison or evaluation of alternatives.

> *(Other reasons for not recommending the development [either in-house or by out-sourcing]) of a standard suite of front-end analysis and measurement tools at this time are:*
>
> - *The WS Builder or similar tool has not yet been developed. Therefore, it is unknown at this time what the requirements will be for integrating "front-end" tools into it. In addition, it is yet to be determined if the tool will be make effective use of the data generated by the analysis and measurement tools.*
>
> - *If there is a value-added benefit in integrating existing tools into the DoD WS Builder tool, then efforts should be made to work with private industry to provide such integration at a more reasonable cost.*
>
> - *If it is feasible and value-added to have a stand-alone, integrated suite of work analysis and measurement tools apart from a work standards development tool, it is assumed that the commercial world will be the first to develop them. (See Appendix E for some potential examples.)*

The following bullets introduce four implementation alternatives to be considered and compared in this section::

- The first, "Status Quo," continues with the current environment—the lack of a common or standard automated system for developing and maintaining work standards.

- The second, "DoD Standard System," is a fully developed and deployed operational WSAP system for one Service or MAJCOM.

- The third, "DoD Functional and Technical Specifications," provides a common system design which can be implemented in modular form to the extent there are requirements and resources to do so.

- The fourth, "Best of Breed," makes use of an existing application package which can be used in a modular form to the extent there are requirements and resources to do so.

5.3.2 Status Quo

Currently there is no standard automated system for the development and maintenance of WS. To the extent that labor standards and staffing standards/models are being developed, various automated tools are being used. These include everything from simple spreadsheets and text files, old 80 column card formats to fairly sophisticated, modern automated tools and applications. Standards are also being stored in a variety of means from text files to large central databases, ranging from manual updating to automated updating. The personnel who currently develop and use labor and staffing standards/models work in numerous work centers from depots to major centers for manpower requirements development. Because there are so many different locations where standards are developed, it is not feasible due to the time constraints of this project to identify the current work standard development systems or to collect data on the costs of operating them.

Also there is no available data on the current work standard development work load or the number of personnel and hours used for work analysis, work measurement, and work standard development. Although several IG reports projected that significant savings at depots could be realized by expanded use of updated and reliable labor standards, the reports did not provide the documentation behind these assertions.

As a result, comparisons and evaluations relative to the current situation will have to be qualitative rather than quantitative.

5.3.3 DoD Standard System

The "DoD Standard System" alternative is a "limited turn-key" approach (See Section 4.5.3 and 4.4.3). It is a fully developed, deployed and operational WSAP system for one Service or MAJCOM as an example of what is possible for all services and components. It would support the processes of developing and maintaining work standards and related work loads, work flow and simulations ("what if" exercises) for particular projects/jobs/DPUs.

> *(Physical specifications are stated here for comparison and evaluation purposes only. The figures used here are estimates. Actual configurations, sites, nodes, sizes, etc. will depend upon the particular requirements, specifications and decisions of the implementing organization and of the implementing design.)*

This system consists of one central WSAP location connected with 20 local WSAP sites containing 7 nodes per site. In addition to the basic WS Builder, this system would include applications for defining work loads, work flows, and performing "what if" scenarios.

This alternative includes:

- Designing the system
- Building the system
- Testing the system
- Procuring necessary hardware and software
- Installing the system
- Writing and producing system documentation
- Writing and producing training materials
- Training the users and administrators of the system

The central site would have a dedicated server of at least a 5 gigabyte hard drive plus backup data storage capacity and telecommunication links for 5 concurrent users. It would house the basic WS Builder and any "smart applications. This server would also house all the work standards developed for Service or Command wide use as well as work standards developed locally but available for re-use by other local sites. The central site would have 10 nodes for use by central site PEs connected via a LAN. These nodes would be either a personal computer or a lap-top computer. Each node would have the capacity to house a copy of the basic WS Builder, two "smart applications" and the current set of work standards under development. *(WS would be stored and managed via the central server.)*

Each local WSAP site would have a server with at least 150 megabyte of hard drive space (plus back up capacity) available for the WS Builder, several "smart applications" and all the local work standards. The local server would have the ability to access the central site and well as other local sites. Each local site would have a LAN with 7 nodes—3 at the local "office" and 4 distributed to local work centers. Each node would be a personal computer/lap-top with the capacity to house a copy of the basic WS Builder, two "smart applications" and a current version of work standards under development. *(Local WS would be stored and managed via the local server.)*

This WSAP design and system would become the standard automated system for developing and maintaining work standards for all DPUs. Other DPUs (from the Services to particular work centers) could purchase or develop their own WSAP systems to meet their needs. WS, standard data sets, and "smart applications" could also be shared among all DPUs.

The development team would consist of four full time professional system designers and developers plus six quarter time functional users. The design and development of the system would take about two years. The installation team would consist of four technical experts, four technical documentation specialists, and four trainers. The trainers would develop and deliver the training for users and administrators of the system. Deployment would take one year to complete.

5.3.4 DoD Functional and Technical Specifications

The "DoD Functional and Technical Specifications" alternative is a "modular expansion" approach (See Section 4.5.4). It provides a common system design which can be implemented in modular form by any DPU to the extent there are requirements and resources to do so. The DoD Functional and Technical Specifications alternative supports the processes of developing and maintaining work standards.

This alternative only develops an implementation design—a production "blueprint"—for a WSAP system and builds a prototype to test the WS Builder design.

> *(Once the design is complete, there may be existing commercial or government applications that will satisfy the design requirements with only a slight amount of modification. If so, then such an application would be modified and made available along with the new design of the WSAP. See 5.5 Package Recommendations and Appendix E for potential COTS candidates.)*

This design would be the standard design for automated support of DoD work standard development and maintenance. This standard design would be made available to any Service, MAJCOM, Installation or work center that would want to implement and deploy a WSAP system in any configuration of central WSAPs, local WSAPs, and related nodes.

The implementation design would describe the production specifications for the information, data and technology requirements for the WSAP. The design would focus on WS Builder which could be modeled after the Resource Planner currently used by the US Navy. The design would include "smart applications" and existing "expert modules" similar to the ones used by the Resource Planner. This design would also make use of standard data sets as well as provide for the migration of existing labor standards and manpower standards/models into the WSAP.

The design entails establishing standards for data, software, hardware and communications for integrating and sharing relative to the development and maintenance of work standards across all WSAP locations. This design, while taking into consideration the requirements for interface with performance management systems and with front-end analysis and measurement tools, will not, at this time, address requirements for establishing such interfaces.

In addition to the design, training materials and courses in the use of the WSAP would be developed to be available for any future users of the WS Builder and the WSAP.

With a standard design, DoD Services, MAJCOM, Activities, installations, functional areas, or particular work centers can customize the standard design to meet their own requirements. The system configuration would consist of a combination of central and local sites with a specified number of nodes at each site. The system options would include:

- The flexibility to add sites and nodes as needed
- An ability to link and share data among sites as needed
- Link and share data among the sites
- The ability to develop or procure "smart applications" and share them across all sites and nodes

- The ability to share work standards

Development of this design and the building of a WS Builder prototype would be done by a development team of four professional system designers and developers and eight functional users. The full time professional developers could be "in-house" or contractors or a combination. The functional users would be represent PEs and managers and would work one-quarter time. A training team of two persons would develop the training curriculum and materials. The development of the design would take from nine to 15 months. The development of training curriculum and materials would take up to six months.

5.3.5 Best of Breed

The "Best of Breed" alternative is the "economy model" approach (See Section 4.5.5). It makes use of an existing application package which can be used in a modular form depending on the requirements and available resources to do so. The "Best of Breed" alternative supports the processes of developing and maintaining work standards.

This alternative quickly refines the general system architecture (Section 4) to a degree necessary to be able to evaluate existing automated tools which could serve as the "WS Builder" component. This refined architecture would be used to select the "best of breed" commercial automated work standard development tool (similar to the aforementioned Resource Planner) which most adequately provides the defined functionality and requirements of the refined architecture. (See Appendix E for some current COTS products which potentially could be considered.)The selected tool would become the standard automation tool for developing and maintaining work standards throughout DoD. Rather than designing and implementing a WS Builder, this approach would use the selected "best of breed" automation tool to be the WS Builder component within the WSAP. Any selected "best of breed" automation tool may need some slight modifications to service successfully manpower requirement development and to provide for migration of existing labor standards and manpower standards/models into the WSAP. This option would involve identifying and validating additional requirements and ensuring that any enhancements needed to service the whole range of work standards are developed. Refining the system architecture and making enhancements would take two system designers three to six months, depending upon the experience of the designers and upon the extent of necessary enhancements.

In all other aspects, this alternative is exactly the same as the DoD Functional and Technical Specifications alternative as it is described in Section 5.3.4 above.

5.4 Package Evaluation

5.4.1 Introduction

This Section provides at a very high level a comparative evaluation of each of the four alternatives which are discussed in Section 5.3. The evaluation criteria are focused around four factors: cost, operations and maintenance, feasibility, and risk. The majority of the assessment is based on qualitative (subjective/non-quantitative) data at this point. This assessment takes into consideration the work which has been conducted during this Delivery Order. The engineering and cost estimations and judgment have been done

using very limited data. The evaluation rating scheme is -1, 0, +1 against each evaluation criteria. This rating scheme ranges from a negative/poor rating (-1) to a positive/good rating (+1) with "0" as a neutral rating.

For purposes of the evaluation, the alternatives have been identified as follows:

Alternative	Name	Description
1	Status Quo	"As Is" Current Situation
2	DoD Standard System	Fully Developed and Deployed Operational WSAP System for One Service or Major Command
3	DoD Functional and Technical Specifications	Common System Design in Modular Form
4	Best of Breed	Existing Application Package in Modular Form

Figure 14: Alternatives

Alternative 1, Status Quo, is a non-viable alternative since neither the DoD IG's recommendation nor the USD(P&R)'s commitment to develop and implement a DoD standardization of automated engineering techniques (work measurement and standards) would be met. Therefore this alternative is not included in the evaluation.

Furthermore, since automated development of work standards using tools similar to the proposed WS Builder, in both commercial and government situations, have demonstrated reduced time and cost per work standard developed, all of the alternatives would be better than leaving the current environment as is. In addition, the ease of using an efficient automated tool, such as WS Builder, will encourage managers to make wider use of more accurate and reliable WS, and in turn lower budgets and produce better performance. *(These evaluations are based upon professional observations and evaluations of situations that have made use of similar automated support for work measurement and labor standards development as are presented here rather than cost comparative studies. Currently, the industrial engineers at the Cherry Point Naval Depot are documenting the cost benefits of developing labor standards with the support of an automated tool similar to the proposed WSAP system.)*

5.4.2 Ground Rules and Assumptions

The following are some of the significant ground rules and assumptions which underlie the assessment of the alternatives:

- Each alternative assumes a common basic data design.
- Each alternative contains the establishment and maintenance of a world-wide web site for sharing information and resources regarding work analysis, work measurement and the development of work standards.

- Each alternative assumes that the WSAP users (particularly central sites) would determine, select, procure and make available automated front end work analysis and measurement tools as needed in the development of work standards for their constituents.

- Each alternative requires access to the central and local management systems.

- Each alternative is viewed as a total DoD buy versus each service selecting the alternative(s) of its choice.

5.4.3 Cost

This Section provides some of the key cost drivers for each alternative from an acquisition perspective. As detailed requirements are developed, a cost-benefit analysis for each alternative may be necessary before the DoD decision makers can make a final choice. The cost estimates contained in this Section are calculated at a very high level and contain ROM figures for software development (labor), deployment and installation (labor), and some equipment dollars. The data are provided only for comparative purposes among the proposed alternatives.

5.4.3.1 Alternative 2 (DoD Standard System)

This alternative is estimated to require four full-time system designers/developers (GS-13 Step 5, $56,504) and six quarter-time functional users (GS-11 Step 5, $39,645) two years to develop the software. The cost estimate for this team totals $570,967 using base 1996 GS pay rates for comparative purposes only among the assessed alternatives.

The deployment/installation effort is estimated to require four full-time technical experts, four half-time technical documentation specialists, and four full-time trainers one year. In addition, the trainers would require an additional six months to complete training on the system. These individuals have been grouped as GS-11 Step 5. The cost estimate for this team totals $475,740 using base 1996 GS pay rates for comparative purposes only among the assessed alternatives.

Estimated equipment costs include one central location with a dedicated server (minimum of 5 gigabyte hard drive) at $3,000 and each node at $2,000. Each local site is estimated at $2,000 for a server (smaller than at the central site) and $2,000 per node.

5.4.3.2 Alternative 3 (DoD Functional and Technical Specifications)

The alternative is estimated to require a team of four full-time developers (GS-13 Step 5, $56,504) and eight functional users available quarter time (GS-11 Step 5, $39,645) fifteen months to develop the software. The cost estimate for this team totals $381,632 using base 1996 GS pay rates for comparative purposes only among the assessed alternatives.

The development of training curriculum materials is estimated for a period of six months using two full-time trainers (GS-11 Step 5). The cost estimate for this team totals $39,645 using base 1996 GS pay rates for comparative purposes only among the assessed alternatives.

This alternative assumes that the equipment will be provided by DoD or the acquiring DPU. This may range from using existing Government equipment to purchasing new

equipment. The approach along with the associated cost estimates would need to be considered if detailed cost estimates are requested at a later date.

5.4.3.3 Alternative 4 (Best of Breed)

The alternative is estimated to require two full-time system designers/developers (GS-13 Step 5, $56,504) and eight functional users (GS-11 Step 5, $39,645) available quarter time six months to develop the requirements. The cost estimate for this team totals $96,149 using base 1996 GS pay rates for comparative purposes only among the assessed alternatives.

The deployment/installation will be provided by DoD or the acquiring DPU. There are also additional costs for development tools including the site licensing fee of approximately $12,000 for an application tool similar to the Resource Planner plus expert modules and standard data at an estimated cost of $4,000. Each site/customer that wishes to install and use the selected automation tool would be responsible for local licensing fees and the purchase of modules and data sets appropriate for the site.

This alternative assumes that the equipment will be provided by DoD or the acquiring DPU. This may range from using existing Government equipment to purchasing new equipment. The approach along with the associated cost estimates would need to be considered if detailed cost estimates are requested at a later date.

5.4.4 Operations and Maintenance

This Section provides the key drivers which are critical for the operation and maintenance of each alternative over the program's life-cycle. For purposes of this analysis, only an annual staffing estimate is provided. During the course of estimating the life-cycle costs for any of the assessed alternatives, the need to account for increasing equipment repair costs and software maintenance must be considered.

5.4.4.1 Alternative 2 (DoD Standard System)

It is estimated that the operations and maintenance for Alternative 2, DoD Standard System, would require one part-time person working at the central location and one person working one-eighth of the time at each of the local sites. There would also be some hardware maintenance for the equipment but the amount would depend on the type of maintenance procured by the customer at that time.

5.4.4.2 Alternative 3 (DoD Functional and Technical Specifications)

The operations and maintenance estimated for Alternative 3, DoD Functional and Technical Specifications, would depend on whether this effort is conducted by the software developer or by the customer in terms of software maintenance. As for system maintenance, communications and local interfaces, the requirements for operations and maintenance would be the same as for Alternative 2—one part-time person at central sites and one person one-eighth time for each local site.

5.4.4.3 Alternative 4 (Best of Breed)

Alternative 4, Best of Breed, would be very similar to Alternative 3. In implementing either of these alternatives a decision about the division of operation and maintenance responsibilities would have to be made.

5.4.5 Feasibility

This Section discusses the feasibility of each alternative including consideration for external factors such as funding constraints, political pressures, and program priority as a result of funding competition. The following Section discuss the negatives and positives of each alternative.

5.4.5.1 Alternative 2 (DoD Standard System)

The main advantages of this alternative include:

- A total system with documentation and specifications
- Provisions for extensive deployment and use from the beginning

The disadvantages include:

- Very high costs
- More standardization than necessary
- A long implementation schedule—two years for development and one year for deployment/installation for a total of three years
- Additional time to develop interfaces with other existing systems

Because of the high cost of this alternative, it will require extensive time and effort to obtain the necessary authorization, funding and participation. In addition, there is no guarantee that the proper authorization or adequate funds can be obtained.

5.4.5.2 Alternative 3 (DoD Functional and Technical Specifications)

The advantages of this alternative include:

- A common, modular design
- Standard applications and format
- "As needed" deployment
- Makes use of available in-house hardware capability of user sites

The disadvantage is that the customer would have to do some development to implement the prototype design for local use. This would require tighter controls and supervision during the software development period. In addition, this would increase local operations and maintenance efforts and their associated costs.

This alternative will require some time and effort to obtain funding and authorization.

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5.4.5.3 Alternative 4 (Best of Breed)

The advantages of this alternative include:

- A common, modular design
- Standard applications and format
- "As needed" deployment
- "Ready to go" with minimal effort

In addition, the selected tool would have been operational for a period of time with a positive, proven track record.

Some disadvantages are that the selected tool may not be able to be enhanced to meet all requirements, particularly for the development of manpower factors. In addition, this alternative may not be robust enough to handle the required workloads.

This alternative will require minimum time and effort to obtain funding and authorization.

5.4.6 Risk

This Section identifies the significant potential risk areas associated with each alternative from the perspective of technical, cost, and schedule areas. This assessment is conducted at a very high level.

One overall risk shared by all of the alternatives is the lack of participation by functional users. Functional user input is critical during the entire development and implementation process. Without this participation the system would not be as effective and would require more time and money to develop.

5.4.6.1 Alternative 2 (DoD Standard System)

Alternative 2 may not be funded because of its high cost and limited resources. In addition this alternative would require high level buy-in. It would have a long start-up effort including funding authorization.

5.4.6.2 Alternative 3 (DoD Functional and Technical Specifications)

A potential issue with Alternative 3 is determining who will maintain the system. This needs to be addressed early in the development phase in order to make a smooth transition into the operation and maintenance phase. If the developers are not going to maintain the software then it is critical that proper and adequate documentation is developed for the system administrators.

5.4.6.3 Alternative 4 (Best of Breed)

A potential issue with Alternative 4 is that the selected automation tool, e.g., the Resource Planner, may not meet all of the functional requirements and the any modifications to the tool would not be possible or take longer than projected. The initial step would identify which (if any) requirements are not met by the identified application and assess and plan a course of action to achieve the required results. Cooperation from the vendor, in permitting and/or cooperating with enhancements, would also be a critical factor.

5.4.7 Comparison of Alternatives

This Section provides a high level assessment of each alternative based on the evaluation criteria listed in Figure 15. The rating system consists of: "1" positive, good; "0" neutral; and "-1" negative, poor. The details of the assessment are provided in Sections 5.4.2 through 5.4.6 respectively.

	DoD Standard System	DoD Functional and Technical Specifications	Best of Breed
Support DoD WM/WS Reqm'ts	1	1	0
Cost	-1	0	1
Development	-1	0	1
Ease to Implement	0	1	1
Operations & Maintenance	-1 to 0	0	0
Schedule	-1	0	1
Feasibility	0	1	1+
Risks	-1	0.5	0.5
Adaptability/ Tailoring	-1	1+	0
Performance Record	NA	NA	0.5
Total	-5	4.5+	6.0+

Figure 15: Alternative Assessments vs. Evaluation Criteria

5.5 Package Recommendations

The preparers of this report offer their recommendations regarding these WSAP alternatives. Besides the information presented in this Section, these recommendations are based on the team's experience during this Delivery Order and on past experience with implementation of similar automated systems.

After analyzing the four alternative presented above, the "DoD Standard System" does not appear to be a prudent alternative due to its high cost, extensive time to secure authorization and funding, and long time frame for development/deployment.

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Furthermore, the atmosphere and trend in DoD is against "standard systems" in the traditional sense.

In terms of low cost, ease of implementation, short time frame required for development/deployment and high feasibility, the "Best of Breed" would seem to be the preferred alternative. The potential drawback of this alternative is the uncertainty that it would be able to support fully the DoD requirements for developing and maintaining work standards—particularly manpower factors—and to be customized to meet special DoD situations. However, until further research is done regarding the capabilities of potential "best of breed" applications, a final conclusion regarding the this alternative cannot be made at this time.

The preliminary results from the comparison of alternatives indicates that the "Best of Breed" is the alternative to choose as indicated by the high-level assumptions and ROM estimates based on a minimal amount of data collected during this Delivery Order task. The "DoD Functional and Technical Specification" alternative, while providing the stronger support of DoD WM/WS requirements and being more adaptable, is longer in development and more costly. But it needs to be kept in mind that the assessment weighed each criteria the same at this time. So in light of overall evaluation, both of these alternatives appear to be about equal.

Therefore, in order to achieve the best of both the "DoD Functional and Technical Specifications" alternative and the "Best of Breed" alternative, while seeking to minimize the weaknesses of both, the "DoD Functional and Technical Specifications" alternative is recommended with the following suggestions for implementation:

- Begin with the development of the detailed architectural design (production specifications).

- Determine what basic functionality is needed, collect the basic transaction requirements (at a logical level), and develop a logical, normalized relational data model of the basic business rules for work standards (work description, time factors and manpower factors). This will be less than the full design originally proposed for this alternative.

- Next, determine if there is a commercial product with application(s) and databases that can support these requirements close enough that it can be readily enhanced or adapted to serve as the "WS Builder. *(If nothing acceptable is found, continue on with the original plan of designing and prototyping the WS Builder. Thus, in this way nothing has been lost and the risk of going with a "Best of Breed" and finding that it really does not do the job is prevented.)*

- If such an application and database is found, procure it with the right to adapt it (or enter into a partnership with the vender to adapt it would probably be quicker and cheaper) to meet the full DoD WSAP specifications. Use this application as the prototype to complete the WS Builder design specifications.

- Make this design and product available as the DoD standard automated work standard support tool. Thus, individual sites would acquire an operational system (as with Alternative 4) and would not have to development their own system from a design and prototype (as with Alternative 3).

In this way DoD controls the design and forces it to meet its requirements (particularly the requirement for customization, expansion and integration with other software applications) while reducing development time and cost by using an existing software application and database. This approach would also provide the speed and ease of deployment and use by DPES sites that is associated with the "Best of Breed" alternative.

APPENDIX A - CONTRIBUTING DOCUMENTATION

A.1. PRIMARY GUIDANCE

DoD Instruction 5010.34, "Productivity Enhancement, Measurement, and Evaluation -- Operating Guidelines and Reporting Instructions" is the primary DoD guidance for Work Measurement/Labor Standards. It is recommended to be replaced by new guidance that reflects the use of work standards as a tool for use in performance measurement and program support. Though work standards are a referenced as a required tool in DoD Instruction 5010.37, "Efficiency Review, Position Management, and Resource Requirements Determination" and though it requires that labor and staffing standards be established, revised and maintained, it does not provide guidance on the mature or development of work standards. (Based upon the shift in paradigm in management proposed in DPPI Phase I, it is likely that DoDI 5010.37 will also be re-written and re-issued.)

A.2. RELATED GUIDANCE

In addition to the primary guidance on work standards, other documents that provide additional context and direction for the development and use of work standards are:

- *Military Standard No. MIL-STD-1567A,* "Work Measurement," March 11, 1983 (reference 42)) provided requirements for the application of work measurement and labor standards by defense contractors.

- *DoD Manual 5010.15-1-M,* "Standardization of Work Measurement," June 13, 1977 (reference 7), provides standard time data and guidelines for uniform application of various industrial and management engineering techniques.

- *DoD Handbook 5010.31-H,* "Training Guide for the Management Analyst and Industrial Engineering Technician," July 1979 (reference 8), provides guidelines for determining and maintaining the educational requirements for an effective staff of management analysts and industrial engineering technicians.

- *AMEC Defense Management Joint Course Book,* "Work Methods and Standards Orientation," undated (reference 32), supports AMEC courses providing DoD joint training in work methods and standards.

- *Defense Logistics Systems Analysis Office Study Report,* "Applications of Statistical Process Control," circa 1988 (reference 52), identified DoD logistics activities which were improving quality by using statistical process control, and recommended a total quality management approach.

- *Military Handbook No. DOD-HDBK-345,* "MID-STD-1567A, Work Measurement Verification and Compliance Plan," June 20, 1988 (reference 53), provides guidance for reviewing work measurement systems used by defense contractors.

- *AMEC Defense Management Joint Course Book,* "Defense Work Methods and Standards," comprising Volume I -- Methods Study, Volume II -- Work

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Measurement, and Volume III -- Workbook, August 1989 (reference 57), provides DoD joint training in work methods and standards.

- *AMEC Handbook,* "Mathematics Review Handbook," March 1995 (reference 75), provides a review of basic algebra for prospective AMEC students.

- *AMEC Test,* "Mathematics Diagnostic Test," undated (reference 76), provides a test of fundamental mathematics and simple problem solving for helping AMEC students identify areas for improvement.

- The documentation cited in the DoD Productivity Program Review Report, Vol. I. dated February 1996, is also relevant to this study. The reader is referred to this document rather than reprint the extensive annotated listing.

A.3. RELATED AUDITS AND STUDIES

The DoD Inspector General (IG) published several audit reports that addressed use of labor standards within the DoD depots. In particular, Audit Report No. 95-049 dated December 8, 1994, presented findings the labor standards were not adequately used or maintained and that there was weak guidance and oversight for the use of labor standards by the Services. Recommendations in this report included update of guidance, stronger oversight, regular use and better automated support for labor standards for appropriate work process. Other studies, such as the Office of Secretary of Defense (OSD) task force in 1992 and a Logistics Management Institute study of Navy depots in 1995 reveal similar problems and make similar recommendations. In support of these findings requirements to develop and implement a comprehensive policy on work measurement and to complete the standardization of automated industrial engineering techniques were identified by the Under Secretary of Defense for Personnel and Readiness, Dr. Edwin Dorn in a memorandum dated February 18, 1995. Details of those evaluations are included in the DPPI Vol. I report. Other studies that discuss work standards are listed below:

- *DoD IG Study Report,* "Work Measurement Systems and Engineered Labor Standards," October 22, 1986 (reference 15), addressed the use of such systems and standards in the production phase of the acquisition process. It did not address the use of such systems and standards in other acquisition phases, such as full-scale development, or in other labor categories, such as office work. The study team proposed a DoD-wide policy designed to ensure that the use of work measurement systems will be appropriate, that the work measurement systems will be based on engineered labor standards, and that the benefits will flow not only to the contractor but also to the government.

- *AFAA Report No. 7106211,* "Development and Use of Air Force Engineered Maintenance Labor Standards," June 28, 1989 (reference 18), stated that 63% of the total programmed depot workload did not have engineered labor standards, 54% of work performance observations did not meet the accuracy criteria, 68% of the required reviews of labor standards were not performed, and 82% of the operations had inadequate supporting documentation, and recommended corrective actions.

- *GAO Report No. GAO/NSIAD-89-171,* "Navy Maintenance, Aviation Component Repair Program Needs Greater Management Attention," July 6, 1989 (reference 19), stated that component repair prices were not adequately supported, audits

and reports were not made, and variances between actual and billed labor hours were not analyzed, and recommended corrective actions.

- *GAO Report No. GAO/NSIAD-90-193BR,* "Navy Maintenance, Improvements Needed in the Aircraft Engine Repair Program," June 18, 1990 (reference 21), stated that significant differences existed in the labor hour estimates developed by different depots to perform the same repair task at the different depots, and recommended corrective actions.

- *DoD IG Audit Report No. 91-039,* "Management of Labor Standards for Airframes at Aeronautical Depots," January 31, 1991 (reference 22), stated that the Military Departments were not developing and updating labor standards and were not performing variance analyses of differences in actual labor hours expended versus standard labor hours for the maintenance and repair of aircraft airframes, and recommended corrective actions.

- *DoD IG Audit Report No. 92-025,* "Use of Work Measurement System Data in Negotiating with Prime Contractors," December 18, 1991 (reference 23), found that work measurement data were not used to negotiate direct labor costs of contracts, and recommended corrective actions.

- *DoD IG Audit Report No. 95-049,* "Follow-up of the Management of Labor Standards at Aeronautical Depots," December 8, 1994 (reference 27), stated that the Military Departments' work measurement programs for managing the development and evaluation of labor standards were ineffective and inconsistently applied to competitive and noncompetitive work loads, and that OSD oversight of the Military Departments' work measurement programs was ineffective. In response to this report, the Under Secretary of Defense for Personnel and Readiness (USD(P&R)) agreed to develop and implement a comprehensive policy on work measurement, complete the standardization of automated industrial engineering techniques, and sufficiently staff the oversight office (reference 28).

- *Defense Logistics Systems Analysis Office Study Report,* "Applications of Statistical Process Control," circa 1988 (reference 52), identified DoD logistics activities which were improving quality by using statistical process control, and recommended a total quality management approach.

- *Military Handbook No. DOD-HDBK-345,* "MID-STD-1567A, Work Measurement Verification and Compliance Plan," June 20, 1988 (reference 53), provides guidance for reviewing work measurement systems used by defense contractors.

- *DoD Task Group on Work Measurement and Application of Standards.* The ASD(FM&P) memorandum, "Task Group on Work Measurement and Application of Standards," April 14, 1991 (reference 63), launched an initiative to address recommendations made by DoD IG Audit Report 91-039 (reference 22). The task group presented the background, findings, recommendations (including work measurement policy recommendations), and proposed plan of action in the "Task Group on Work Measurement and Information Management Report" in early 1992 (reference 64).

- *Naval Air Systems Command (NAVAIR) Study of Naval Aviation Depot (NADEP) Industrial Operations Standards.* The NAVAIR contracted with the Logistics Management Institute (LMI) to review NADEP industrial operations standards. The LMI Report NA505RD1, "Naval Aviation Depot Industrial Operations Standards," July 1995 (reference 80), reviewed potential efficiency improvements that may result from updating industrial operations standards (including both labor and material standards) and implementing the Depot Maintenance Standard System in NADEPs. This report addressed recommendations made by DoD IG Audit Report 95-049 (reference 27), and developed specific conclusions and recommendations regarding industrial operations standards (including both labor and material standards).

A.4. RELATED BOOKS AND ARTICLES

The following books and articles also provided an updated understanding of the development and use of labor standards in the business world today.

- Motion and Time Study, 7th edition; Marvin E. Mundel and David L. Danner; Prentice-Hall, Inc., 1994.

- Handbook of Industrial Engineering, is a complication of papers on various aspects of industrial engineering and its application to various types of businesses.

- *Reserve Space in Your Toolbox for Low-Tech Work Measurement*, by John H. Johnston in *Industrial Engineering*, Vol. 27, No. 4, April 1995.

- *Work Measured Labor Standards: The State of the Art*, by Royal Dossett, in *Industrial Engineering*, Vol. 27, No. 4, April 1995.

- *Using Manufacturing Operations Measurements to Achieve Planned Performance Results*, by Kenneth G. Merkel in *Industrial Engineering*, Vol. 27, No. 4, April 1995.

- *Re-Tayloring the Shop Floor*, by Jose Ricardo DosSantos, in *IIE Solutions*, May 1995.

- *Work Measurement Techniques*, in *Journal of Accountancy*, April 1988, pp. 104ff.

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APPENDIX B - AS-IS IDEF0 MODEL AND GLOSSARY OF TERMS

B.1. THE IDEF0 MODEL

USED AT:

AUTHOR: Defense Productivity Support Office   DATE: 14 June 1996
PROJECT: Labor Standards Process   REV: 5 Sep. 1996

NOTES: 1 2 3 4 5 6 7 8 9 10

READER   DATE   CONTEXT:

WORKING
DRAFT
RECOMMENDED
PUBLICATION

TOP

Inputs / Controls / Outputs:

- Customer Request for Work Standards
- Authorized Work Process Change
- Productivity Program Wide Plans
- Productivity Program Wide Guidance
- External Work Standard

- Instructions on use of Work Standards
- Work Standards
- Work Process Change Recommendations
- Validated Measured Work Data
- Work Measurement Plan
- Trend Analysis

- Work Standard Data Systems
- Managers
- Productivity Technician
- Personnel

- Productivity Research & Study Reports
- Reported Performance Data
- Current Work Processes Information
- Improvement Recommendations

DEVELOP WORK STANDARDS

A0

Purpose: To define the activities associated with the identification and improvement of work standards and workload data collection.

Viewpoint: Productivity Office

NODE: A-0   TITLE: DEVELOP WORK STANDARDS   NUMBER:

USED AT:	AUTHOR: Defense Productivity Support Office	DATE: 14 June 1996	WORKING	READER	DATE	CONTEXT:
	PROJECT: Labor Standards Process	REV: 5 Sep. 1996	DRAFT			TOP
			RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			A-0

Inputs (left side):
- Customer Request for Work Standards
- Productivity Program Wide Plans
- Productivity Research & Study Reports
- Improvement Recommendations
- Current Work Processes Information
- Reported Performance Data
- Authorized Work Process Change
- Productivity Program Wide Guidance

Boxes:
- **PLAN WORK MEASUREMENT** A1
- **ESTABLISH WORK STANDARDS** A2
- **ASSESS WORK STANDARDS** A3
- **SUPPORT APPLICATION AND MAINTENANCE** A4

Arrows / labels:
- Work Measurement Plan
- Instructions on use of Work Standards
- Work Process Change Recommendations
- Work Standards
- Validated Measured Work Data
- Trend Analysis
- Taylored Standards
- Work Standard Validation Feedback
- Productivity Technician
- Managers
- Defined Work Scope
- External Work Standard
- Recommended Changes to Work Scope
- Work Standard Assessment Report
- Workload History
- Workload Forecast
- Work Standard Data Systems
- Personnel
- Manager & Productivity Technician

NODE: A0   TITLE: DEVELOP WORK STANDARDS   NUMBER:

B-2   CP1O0201

USED AT:

AUTHOR: Defense Productivity Support Office | DATE: 18 June 1996 | WORKING
PROJECT: Labor Standards Process | REV: 5 Sep. 1996 | DRAFT / RECOMMENDED / PUBLICATION

NOTES: 1 2 3 4 5 6 7 8 9 10

READER | DATE | CONTEXT:

A0

DOCUMENT WORK PROCESS FOR MEASURMENT — A2.1

DETERMINE WORK STANDARD — A2.2

ISSUE WORK STANDARD — A2.3

VALIDATE WORK STANDARD — A2.4

Work Measurement Plan
Authorized Work Process Change
Recommended Changes to Work Scope
Work Process Change Recommendations
Work Standards
Work Standard Update Recommendations
Validated Work Standards
Work Standard Data Systems

External Work Standard
Productivity Program Wide Guidance
Measureable Work Process Description
Draft Work Standard
Productivity Technician

Defined Work Scope
Work Standard Validation Feedback
Current Work Processes Information
Work Standard Assessment Report
Reported Performance Data
Process Information Feedback
Worker & First Line Managers
Personnel

NODE: A2 | TITLE: ESTABLISH WORK STANDARDS | NUMBER:

DO-0121

24 March 1997

USED AT:

AUTHOR: Defense Productivity Support Office | DATE: 18 June 1996 | WORKING | READER | DATE | CONTEXT:

PROJECT: Labor Standards Process | REV: 5 Sep. 1996

DRAFT
RECOMMENDED
PUBLICATION

NOTES: 1 2 3 4 5 6 7 8 9 10

A0

Work Measurement Plan

Productivity Program Wide Guidance

Work Standard Assessment Report

Review Report / Recommendations

Validated Measured Work Data

REPORT MEASURED WORK DATA — A3.4

Managers

REVIEW WORK MEASUREMENT PROGRAM — A3.3

Variance Report

Trend Analysis

ANALYZE TRENDS — A3.2

PERFORM VARIANCE ANALYSIS — A3.1

Work Standards

Reported Performance Data

Productivity Technician

Work Standard Data Systems

TITLE: ASSESS WORK STANDARDS

NUMBER:

NODE: A3

B-5

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B.2. THE GLOSSARY OF TERMS

Arrow Name	Arrow Definition
Allocated Resources	Resources (e.g., personnel, money, supplies, and equipment) which have been assigned to particular tasks of providing work standards.
Authorized Work Process Change	Recommended changes to the 'current' work processes which have been approved to be implemented. These changes may come from the functional manager or from process improvement efforts. Also this involves any other improvements/changes which have been made in a process since the issuance of a work standard and prior to its validation for that process.
Current Work Processes Information	Information about work processes as they are currently being performed. This information may come from subject matter experts, functional users, printed matter, and/or databases.
Customer Request for Work Standards	Any request or instruction to develop, update or otherwise provide work standards. Such requests are from some level of management such as PSA, functional proponent, functional manager, 1st Line Manager, field managers, etc..
Defined Work Scope	The particular work process for which work standards are to be developed and/or updated and which first needs to be improved.
Draft Work Standard	A work standard which has been developed by use of some work measurement methodology but has not yet been issued.

External Work Standard	Work Standards or work standard data which are produced and/or used by organizations (Government or Commercial) external to the given organization that is developing work standards and which standards may be applied or adapted for use in the given organization in its work processes. This includes Defense Work Measurement Standard Time Data (DWMSTD).
Improvement Recommendations	Recommendations from various sources (workers, IG, customers, superiors, etc.) as to improvements for productivity in terms of work processes and work standards.
Instructions on use of Work Standards	
Manager & Productivity Technician	
Managers	Any manager who is responsible for planning and assessing the performance (the work and its results) of an organization, function, or any element thereof. They are the ones who make use of work standards in the management of the work of their area of responsibility.
Measurable Work Process Description	Models, work flow diagrams, charts, text and other information which describe and document current given work for determining work standard(s) to cover this process.
Personnel	
Process Information Feedback	Feedback from the effort to establish work standards regarding the improvement of the work process for which the standard is being measured.

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Productivity Program Wide Guidance	The authoritative direction, instruction, advice, opinion or decision prescribed for all defense productivity improvement programs under the auspices of the DoD Productivity Program. This includes regulations, directives, programs that require work standards.
Productivity Program Wide Plans	The authoritative vision, mission, guiding principles, values, strategies, goals, objectives, and related implementing guidelines prescribed for all defense productivity improvement programs under the auspicious of the DoD Productivity Program.
Productivity Research & Study Reports	Productivity Research and Study Reports are the documented results of research and studies conducted to inform technical and managerial decisions effecting productivity.
Productivity Technician	Those responsible for the development and maintenance of work standards, such as industrial engineers/analysts and management analysts.
Recommended Changes to Work Scope	Feedback from improvement efforts recommending changes in the scope of the work process assigned for improvement.
Reported Performance Data	Data as to outputs, inputs, effectiveness, efficiency, and processes which are monitored and reported. Particularly in this case, this is productivity data (results) of work covered by labor standards and staffing standards.
Review Report / Recommendations	The documentation, analysis and evaluation of the work measurement and standards program along with comments and recommendations.

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Standard Type, Level, and Method	The type of work standard, the measurement method to be employed and the level of detail to be measured which are appropriate (value added) for a given work process. This also includes information about level of both the accuracy of the standard and the reliability of data that will be appropriate.
Study Steps	The particular steps or tasks needed to develop and assess work standards such as a staffing study plan or a labor standards maintenance plan.
Task Schedules	The assignment of times for accomplishment of work breakdown tasks for providing work standards support for a given work processes.
Tailored Standards	
Trend Analysis	The results of analyzing and evaluating trends in productivity as revealed by productivity data.
Validated Measured Work Data	Reports based on validated data of actual work done as measured according to work standards. These reports include proper accounting codes, actual hours worked, and the like.
Validated Work Standards	
Variance Report	The results of a completed variance analysis.
Work Measurement Plan	
Work Process Change Recommendations	Assessment of current work process along with recommendations for changes (improvements) in a work process or in things effecting a work process, i.e. regulations, facility, equipment, etc..

Work Standard Assessment Report	A composite output made up of a Variance Report, a Trend Analysis, and/or a Review Report/Recommendations.
Work Standard Data Systems	
Work Standard Update Recommendations	
Work Standard Validation Feedback	
Work Standards	New and updated standards which related time, worker and task. Labor standards state the amount of time it should take a skilled worker (or group of workers) to perform a defined task under specified conditions. Staffing standards state the number of workers required to do a task within a year or some other stated amount of. Work Standards include engineered and non-engineered labor standards. These standards may be developed using any one of a variety of methods and reflect a range of various particular situations. A standard includes a description of the work to which the standard applies and instructions on how to apply the standard.
Worker & First Line Managers	
Workload Forecast	Projected amount of work (type, volume, etc.) to be accomplished.
Workload History	Documented amount of work (type, volume, etc.) which has been accomplished in particular time periods in the past.

Activity Name	Activity Definition
ANALYZE TRENDS	The activity of comparing productivity data over a period of time at regular intervals to ascertain patterns and/or directions of productivity results and their meaning. Steps involved: 1) collect the data, 2) analyze data for significance, 3) make observations, 4) adjust standards if necessary.
ASSESS WORK STANDARDS	The activity of monitoring, analyzing, and evaluating the program of developing and maintaining work standards as a whole and providing recommendations and feedback. This includes activities of performing variance analysis for existing work standards, of analyzing trends relative to work productivity, of review of the work measurement program, and of providing data on work measured with the standards.
ASSIGN RESOURCES	The activity of assigning resources (e.g., personnel, money, supplies, and equipment) necessary to carry out the specific tasks of developing and/or assessing work standards.
DECIDE APPROPRIATE STANDARDS	The activity of deciding the kind and precision (degree of engineering/level of accuracy required) of standards that are appropriate (value added) for a given work process, determining the level of work breakdown at which the standards will be set, selecting the appropriate method for measuring the work, and deciding other issues of feasibility and desirability for setting and maintaining work standards for a given work process. Steps involved: 1) noting the type and level of standards required by the targeted work area, 2) discussion with manager, 3) deciding where [location] to measure, 4) deciding the scope of the study, 5) evaluate the work and relevant measuring techniques, 6) determine the method for measurement.

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DETERMINE MEASUREMENT TASKING	The activity of determining the specific tasks to be done in developing and/or assessing work standards for a given work process(s).
DETERMINE WORK STANDARD	The activity of applying the selected method for measuring the work and developing the related standard(s). It also involves determining the skill/training level required to do the work/task and specific conditions related to the measured work. Steps involved: 1) develop measurement plan, 2) collect data, 3) measure the time, 4) do computations, 5) define conditions, 6) define PFAD, 7) determine training requirements, 8) review regulations and manuals, 9) write report, 10) submit report/standards for QA.
DEVELOP WORK STANDARDS	The activity of developing and maintaining standards of work time. These standards include labor standards (engineered and non-engineered) and staffing standards.

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DOCUMENT WORK PROCESS FOR MEASURMENT	The activity of documenting how the given work process (the one for which standards are to be developed) is currently being done and ensuring that the process description is adequate and proper for creating a work standards. This involves breaking down the process into its component parts (methods, tasks, procedures, etc.) and defining each. The breakdown will be to the level of tasks to be measured. This activity may include defining the equipment used in the process, the layout of the work and/or facility, the material used in the process, environment, and other factors influencing the way the execution of the work. Some steps involved for labor standards: 1) talk with line manager and workers about tasks being measured, 2) observe the tasks, 3) create flow chart of tasks, update process description, 5) estimate frequency, 6) define work content. Some steps involved for staffing standards: 1) interviews with workers and managers, 2) conduct process improvement workshops, 3) conduct site visits. If validation or update of existing standards is being done, this activity involves documenting and incorporating what processes and related conditions have changed from the existing standard. In the process of documenting the given work process, problems or issues may be identified. Furthermore, recommendations for improvements in organization, process, equipment, layout, materials, environment, staffing, and other factors influencing the execution of the work maybe made. Also, part of this activity is evaluating the feasibility of the kind of standard and/or the method of standard development being employed. All of these are communicated to the manager for proper action.

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ESTABLISH WORK STANDARDS	The activity of documenting the work process for measurement, determining work standards for the given process, issuing new or updated standards, validating the standards, and updating the system that maintains the list of standards and that measures the actual work which is done under these standards.
IDENTIFY WORK TO BE MEASURED	The activity of determining the work processes for which standards need to be developed or assessed over time, e.g., a major effort, a discrete task, a position/job classification, etc.) Steps involved: 1) meeting with manager, commander, or HQ staff to decide area of work to be measured, 2) review inventory list of standards and work areas to be addressed.
ISSUE WORK STANDARD	The activity of publishing the validated work standards for use and making them available (distributing) for use by managers. It is also the activity of updating any and all appropriate system(s) which use/support work standards.
PERFORM VARIANCE ANALYSIS	The activity of comparing the productivity which should have been accomplished for a task according to the standard and the actual productivity for that task. Where there is meaningful difference between the standard and the actual productivity, analysis is made to determine the cause of the variance. Based on the analysis, recommendations are made to remove the cause for the variance. Steps involved: 1) monitor/collect data on actual performance results, 2) compare to the work standards, 3) if results are out of range, make the manager aware of it, 4) analyze for the cause of being out of range, 5) publish findings, 6) adjust standards accordingly, if they are the problem.

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PLAN WORK MEASUREMENT	The activity of identifying the work to be measured, deciding the appropriate level and type of standards to be developed (if any), defining the tasks, assigning resources to the tasks, and scheduling the tasks.
REPORT MEASURED WORK DATA	The activity of reporting various data relative to time spent on various tasks as measured by work standards. This includes verifying the man-hour account codes, etc. Steps involved: 1)Collect data, 2)validate data, 3)make adjustments(correct labor codes, etc.) 4)fix problems, 5) document manpower requirements.
REVIEW WORK MEASUREMENT PROGRAM	The activity of reviewing (analysis, evaluation and recommendations) the effort of establishment and maintenance of work standards. This includes identifying those labor standards that need to be re-evaluated and updated by the work measurement personnel as well as the review of performance efficiencies of work standards.
SCHEDULE TASKS	The activity of laying out the work measurement tasks over time -- who will do what when and where.
SUPPORT APPLICATION AND MAINTENANCE	The activity of applying staffing standards annually to an organization, function or program to analyze and evaluate manpower utilization and requirements. At this time, the staffing standards are evaluated and updated as necessary. Steps included: 1) applying staffing standards, 2)Noting manpower used, 3)analyzing labor utilization, 4) program performance evaluation, 5)evaluation of manpower requirements, 6) looking at trends, 7) projecting manpower requirements, and 8) updating staffing standards.

VALIDATE WORK STANDARD	The activity of directing the initial application and/or applying the work standard to new or different situations (locations) to ascertain if it is accurate and helpful. Modifications, adjustments or exceptions may need to be added for particular situations/locations.

APPENDIX C - TO-BE IDEF0 MODEL AND GLOSSARY OF TERMS

C.1. THE IDEF0 MODEL

USED AT:

AUTHOR: DPSO	DATE: 24/9/1996	WORKING	READER	DATE	CONTEXT:
PROJECT: DPPI 2 To-Be	REV: 3/21/1997	DRAFT			TOP
		RECOMMENDED			
NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			

General Plans, Programs, Budgets, Guidance

Planning, Programs, & Budgets

Performance Data

Manage Performance (Support)

A0

External Feedback

Operational Information

Operational Materials

Industrial Engineers & Management Engineers

Purpose: To Document the DPPI Phase II To-Be version of the DPPI Phase I To-Be Model.

Viewpoint: Industrial Engineer/Management Engineer

| NODE: A-0 | TITLE: Manage Performance (Support) | NUMBER: |

Manage Performance (Support)

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DRAFT
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PUBLICATION

A-0

NOTES: 1 2 3 4 5 6 7 8 9 10

Blocks / labels in diagram:
- Develop Operational Plan A1
- Execute Operational Plans A2
- Assess Performance A3
- Enhance Performance A4
- Provide Performance Engineering Support A5

Labels:
- Performance Measures & Goals
- Performance Plan
- General Plans, Programs, Budgets, Guidance
- Operational Information
- External Feedback
- Operational Materials
- Operational Planning Feedback
- Total Personnel Factor
- Performance Results
- Operational Experience
- Resource Configuration Change
- Work Standards Update
- Performance Assessment
- Performance Engineering Feedback
- Planning, Programs, & Budgets
- Performance Data
- Work Standards
- WBS & TC
- PE Support Request
- Performance Enhancements Recommendations
- PE Assigned Resources & Automated Systems
- Industrial Engineers & Management Engineers M1
- O1
- O2
- C1
- I2
- I1
- I3

NODE: A0 | TITLE: Manage Performance (Support) | NUMBER:

C-2

CP1O0201

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	PROJECT: DPPI 2 To-Be	REV: 10/25/1996			
	NOTES: 1 2 3 4 5 6 7 8 9 10	WORKING			
		DRAFT			A0
		RECOMMENDED			
		PUBLICATION			

O1

O2

O6 O3 O5

Planning, Programs, & Budgets

Performance Measures & Goals

Resource Configuration Change

WBS & TC

Specific Budgets

Prepare Performance Budgets
A15

Specific Programs

Budgeting Feedback

Design Performance Programs
A14

Low Level PM & Goals

Performance Plan

Work Standards

C2

Create Performance Plan
A13

Strategic Plan

High Level PM & Goals

Develop Strategic Plan
A12

General Plans, Programs, Budgets, Guidance

C1

Specific Guidance

Planning Information

Manage Planning
A11

Operational Planning Feedback
I3

Operational Information
I1

Feedback
I2

Planning Feedback

M1   PE Assigned Resources & Automated Systems

NODE: A1

TITLE: Develop Operational Plan

NUMBER:

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| | PROJECT: DPPI 2 To-Be | REV: 10/25/1996 | | | |

NOTES: 1 2 3 4 5 6 7 8 9 10

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PUBLICATION	

A1

Create Performance Plan

NODE: A13   TITLE: NUMBER:

O4 — WBS & TC
O1 — Low Level PM & Goals
O2 — Resource Configuration Change
O3 — Performance Plan
O5 — Planning Feedback

A131 — Determine The Work We Need To Do
A132 — Determine How We Will Do The Work
A133 — Determine Resources Needed To Do The Work
A134 — Prepare Performance Plan

Specific Guidance
High Level PM & Goals
Strategic Plan C3
Specific Guidance
Macro WBS & TC
Micro WBS & TC
Low Level PM & Goals
WBS & Tasking Codes
Work Standards
C4
C2 C1
Resource Requirements
Method Change Recommendation
PE Assigned Resources & Automated Systems
M1
Budgeting Feedback
I2

USED AT:

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PUBLICATION

A13

Work Standards

C2 C3 C5

WBS & Tasking Codes

Strategic Plan

Specific Guidance

C4

Total Personnel Requirement

I1 Specific Guidance

Estimate Staffing Requirements
A1331

Estimate Other Resource Requirements
A1332

Document Resource Requirements
A1333

Non-Personnel Resources Requirements

PE Assigned Resources & Automated Systems
M1

Resource Configuration Change O1

Method Change Recommendation O3

Resource Requirements O2

TITLE: Determine Resources Needed To Do The Work　　NUMBER:

NODE: A133

DO-0121

24 March 1997

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			DRAFT		
			RECOMMENDED		
			PUBLICATION		A0

Assess Performance

Performance Measures & Goals

C1 Performance Plan

Evaluation Requirements

Analysis Requirements

Monitoring Requirements

Planning, Programs, & Budgets

C3 C2

C4 Work Standards

Manage Assessment A31

Monitor Performance A32

Analyze Performance A33

Evaluate Performance A34

Recommend Changes A35

Performance Results

Monitored Results

Selected Performance Results

Analysis Results

Selected Analysis Results

Evaluation Results

Selected Evaluation Results

Performance Assessment O1

Recommended Corrections and Feedback

Work Standards Update O3

Assessment Process Feedback

PE Assigned Resources & Automated Systems

M1

I1 Performance Results

| NODE: | TITLE: | NUMBER: |
| A3 | Assess Performance | |

C-6

CP1O0201

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| | WORKING | | |
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| | RECOMMENDED | | |
| | PUBLICATION | | |

Performance Plan
Performance Assessment
Operational Experience
I1
I2

C1 C2 Planning, Programs, & Budgets
C3 Work Standards
Performance Improvement Guidance
Performance Improvement Requirements

Manage Performance Enhancements A41

Design Operations Improvement A42

Validate Operations Improvement A43

Deploy Operations Improvement A44

Oversee Enhancement Projects A45

Business Analysis And Recommendations
Improvement Design Package
Authorized Improvement Design Package
Authorized Package For Deployment
Improvement Implementation Package
Improvement Deployment Results
Performance Enhancements Recommendations
(Approved) Improvement Project Products
PE Assigned Resources & Automated Systems
PE Support Request

M1
O1
O2

NODE: A4 | TITLE: Enhance Performance | NUMBER:

C-7

CP1O0201

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		WORKING			
		DRAFT			
	NOTES: 1 2 3 4 5 6 7 8 9 10	RECOMMENDED			
		PUBLICATION			A0

A5 node diagram — Provide Performance Engineering Support

Boxes:
- A51 Manage Performance Engineering
- A52 Develop Work Standards
- A53 Promote Performance Engineering
- A54 Expand PE Services
- A55 Provide PE Data Support

Labels:
PE Assigned Resources & Automated Systems — O2
Work Standards — O1
Performance Engineering Feedback — O3
PE Automated Systems
Performance Engineering Information — (4)
PE Methods & Techniques
Enhanced PE Services & Skills
Promotion Material and Information
Performance Engineering Direction
WBS & TC — C1
Performance Plan — C2
PE Assigned Resources
Work Measurement Plan
Planning, Programs, & Budgets — C3
PE Support Request — I2
Operational Information — I5
Operational Experience — I3
Resource Configuration Change — I4
Work Standards Update — I6
Performance Enhancements Recommendations — I1
Performance Results — I7
Industrial Engineers & Management Engineers — M1
Workers
Managers

NODE: A5   TITLE: Provide Performance Engineering Support   NUMBER:

USED AT:

| AUTHOR: DPSO | DATE: 24/9/1996 | READER | DATE | CONTEXT: |
| PROJECT: DPPI 2 To-Be | REV: 1/22/1997 | | | |

NOTES: 1 2 3 4 5 6 7 8 9 10

WORKING	
DRAFT	
RECOMMENDED	
PUBLICATION	A5

WBS & TC C5

Planning, Programs, & Budgets C2

Performance Engineering Direction C3

Work Measurement Plan C1

Operational Experience I1

Operational Information I2

Work Standards Update I4

Resource Configuration Change I3

Performance Results I6

Performance Enhancements Recommendations I5

Industrial Engineers & Management Engineers M1

PE Automated Systems M3

Workers M2

Describe Units of Work A521

Develop Work Time Factors A522

Develop Total Manpower Factor A523

Work Description

Work Time Factors

Total Manpower Factors

Work Standards O1

NODE: A52

TITLE: Develop Work Standards

NUMBER:

C-9

CP1O0201

DO-0121

24 March 1997

USED AT:

AUTHOR: DPSO

PROJECT: DPPI 2 To-Be

NOTES: 1 2 3 4 5 6 7 8 9 10

DATE: 10/15/1996
REV: 10/25/1996

WORKING	READER	DATE	CONTEXT:
DRAFT			
RECOMMENDED			
PUBLICATION			A52

Work Description C1 C4 Work Measurement Plan

C2

C3 Performance Engineering Direction

Planning,
Programs,
& Budgets

Specify Units Of
Output (WC)
A5221

Work Counts

Specify Units
Of Input
(WT)
A5222

Work Times

Specify
Allowances
(A)
A5223

Allowances

Specify
Ratings
(M)
A5224

Modifiers

Document
Results
(ST = WC/WTXM+A)
A5225

Work Time Factors O1

Work Standards
Update

I1

M1

M2

PE Automated Systems

Industrial
Engineers &
Management
Engineers

TITLE: Develop Work Time Factors

NODE: A522

NUMBER:

C-10

CP1O0201

C.2. THE GLOSSARY OF TERMS

ARROW NAME	ARROW DEFINITION
(APPROVED) IMPROVEMENT PROJECT PRODUCTS	The results of reviewing and assessing all the products from enhancement design, validation, and deployment activities. These are either returned to its source as direct feedback and/or addressed to the enhancement steering group for use in their management of and planning for the improvement effort.
ALLOWANCES	This is the allowances for the given application of the time standard to adjust the time standard to real people. Allowances include such factors as fatigue, breaks, illness, etc.
ANALYSIS REQUIREMENTS	Requirements, created in the management of assessment, setting forth what and how to study, in detail, the performance results obtained by monitoring the performance of any DoD Defense Performance Unit , as well as the requirements for reporting analysis results. These requirements are based upon the performance plan for the Defense Performance Unit.
ANALYSIS RESULTS	Conclusions ensuing from detailed study of selected performance results which has been done according to the analysis requirements. These may include the results of variance analysis, explanation of causes for identified problems, trends, etc.
ASSESSMENT PROCESS FEEDBACK	Evaluations and recommendations regarding the processes and methods used in the assessment of performance results.
AUTHORIZED IMPROVEMENT DESIGN PACKAGE	All designs for improving operations, based on the Business Analysis and Recommendations and on the Improvement Design Package, that have been authorized to be validated. This authorized package provides the guidance for Validate Operations Improvement.
AUTHORIZED PACKAGE FOR DEPLOYMENT	Operations Improvement package, based on improvement implementation package, authorized by management for deployment (fully operational) in all related Defense Performance Units.
BUDGETING FEEDBACK	Data that is a result of Performance Budgeting that can effect the design of the Performance Programs and other planning activities.

BUSINESS ANALYSIS AND RECOMMENDATIONS	The results of any type of system analysis of a current Defense Performance Unit, its problems and its potential improvements and of the proposed changes for the Defense Performance Unit, along with recommendations on improving performance. Such a package is created by design of operations improvement in the Enhance Performance process.
ENHANCED PE SERVICES & SKILLS	An updated listing of the services provided by and skills available from Performance Engineering Support, and related information.
EVALUATION REQUIREMENTS	Requirements created in the management of performance assessments for making critical and interpretive judgments about selected analysis results of the performance of a Defense Performance Unit . These requirements are informed by the performance strategy, plans and expectations for the Defense Performance Unit and its parent Defense Performance Unit.
EVALUATION RESULTS	Conclusions ensuing from detailed study of and/or judgments about selected analysis results obtained in the analysis of a Defense Performance Unit's performance.
EXTERNAL FEEDBACK	Comments, suggestions, recommendations, observations, etc., concerning the performance of a Defense Performance Unit which comes from outside of that Defense Performance Unit (DPU).
GENERAL PLANS, PROGRAMS, BUDGETS, GUIDANCE	This arrow is a composite of the General Plans, Programs, Budgets, and Guidance from the Phase 1 To-Be Model. Importance for this Model: They carry the "requested"/authorized workload for a DPU.
HIGH LEVEL PM & GOALS	Performance Measures (indicators) and Goals (target values) that are developed to the highest level required to meet mission goals and objectives. These Performance Measures and Goals are the basis for further detailing. Includes program goals.
IMPROVEMENT DEPLOYMENT RESULTS	Status and information (figures, statistics, data, observations, and evaluations) regarding the deployment of the operations improvement.
IMPROVEMENT DESIGN PACKAGE	A proposed plan for improving operations, including models and requirements for new processes, procedures, facilities, equipment, information resource management systems, organization, regulations, etc.

IMPROVEMENT IMPLEMENTATION PACKAGE	All the various results of developing and testing authorized operations improvements, of evaluating these improvements, and recommendations for the deployment of the tested/evaluated improvements.
INDUSTRIAL ENGINEERS & MANAGEMENT ENGINEERS	These two classifications of personnel are the primary technical resources which provide performance engineering support.
LOW LEVEL PM & GOALS	Performance Measures (indicators) and Goals (target values) that are developed to the lowest level required to meet mission goals and objectives. Includes program goals.
MACRO WBS & TC	Macro Work Breakdown Structure and Tasking Codes.
MANAGERS	Personnel who are responsible for command and oversight of processes and to plan and obtain performance results which accomplish the mission of their DPU.
METHOD CHANGE RECOMMENDATION	Recommendations to adjust how the work is to get done based on information discovered while developing the resource requirements.
MICRO WBS & TC	Micro Work Breakdown Structure and Tasking Codes.
MODIFIERS	The modifier is used to adjust the meaning of WT with respect to the real world and is called "a rating."
MONITORED RESULTS	Raw figures, statistics, and data of performance results measured according to monitoring requirements (based on performance plans) and other specific controls.
MONITORING REQUIREMENTS	Requirements, created in the management of performance assessment, setting forth what and how to observe performance data resulting from the execution of operational plans by any Defense Performance Unit, as well as the requirements for reporting monitored results. These requirements are based primarily upon the performance plan for the Defense Performance Unit.
NON-MANPOWER RESOURCES REQUIREMENTS	Resource requirements other than manpower for the workload, i.e., facilities, equipment, materials, etc.
OPERATIONAL EXPERIENCE	Knowledge and information about a work process gained from the experience of doing work (executing operational plans). Usually there is no documentation but is carried in the memory of personnel.

OPERATIONAL INFORMATION	All data and information from outside of a DPU relative to performing work, operating equipment, etc.
OPERATIONAL MATERIALS	Physical materials used in executing operational plans (e.g., paper, malfunctioning vehicles, replacement parts, paint, etc.) to produce products and/or services.
OPERATIONAL PLANNING FEEDBACK	Performance Assessment, Performance Enhancement, and Performance Engineering data, observations and comments used in the planning functions and in execution of plans.
PE ASSIGNED RESOURCES	These are the Performance Engineering personnel assigned to assist the managers in planning, assessing and enhancing performance.
PE ASSIGNED RESOURCES & AUTOMATED SYSTEMS	These are automated systems and Performance Engineering personnel assigned to assist the managers in planning, assessing and enhancing performance.
PE AUTOMATED SYSTEMS	These are the automated systems used by the PE Support Engineering personnel.
PE METHODS & TECHNIQUES	The documented PE methods and Techniques to be used in assisting managers.
PE SUPPORT REQUEST	Requests for Performance Engineering Support.
PERFORMANCE ASSESSMENT	A composite of all assessments made of a Defense Performance Unit's performance, including monitored results, analysis results, evaluation results, and recommended corrections and feedback.
PERFORMANCE DATA	This arrow is a composite of the Performances Measures, Goals, Results, Assessments and Enhancements.
PERFORMANCE ENGINEERING DIRECTION	Management direction for the execution of "Performance Engineering" activities and services.
PERFORMANCE ENGINEERING FEEDBACK	A composite of the "Promotion Material and Information" and "PE Methods & Techniques" to inform and assist in the development of operational plans, the assessment of performance, and enhancement of performance.
PERFORMANCE ENGINEERING INFORMATION	Performance Engineering data and information that is available from PE repository(s) and other PE related systems.

PERFORMANCE ENHANCEMENTS RECOMMENDATIONS	A composite of all recommended enhancements for a Defense Performance Unit's organization, procedures, standards, resources, environment, etc. for the purpose of improving performance and/or results. It also includes all the results of improvement efforts, status of improvement efforts, and general feedback information. Final authorization of changes is made in Develop Operational Plans.
PERFORMANCE IMPROVEMENT GUIDANCE	Guidance (strategy, plans, budgets, decisions, authorization, advice, instructions, guidelines, etc.) from performance enhancement management for conducting a performance improvement effort (designing, validating, and deploying operations improvement). This also includes the feedback from the management/steering group for specific improvement efforts.
PERFORMANCE IMPROVEMENT REQUIREMENTS	That part of Performance Improvement Guidance that provides the tasking, other guidance, and management communications for launching an improvement effort and designing an operations improvement.
PERFORMANCE MEASURES & GOALS	High and low level Performance Measures (indicators) and Goals (target values) that defines the accomplishment of mission goals and objectives at the required level of detail breakdown.
PERFORMANCE PLAN	The yearly (or shorter) tactical plan that shows how the mission goals and objectives are to be achieved by the execution functions. It may be a proposed (future) plan, or a production/execution (current) plan. The Performance Plan describes the particular workload for a DPU.
PERFORMANCE RESULTS	The sum total of the products and services of a Defense Performance Unit, as well as the data about them.
PLANNING FEEDBACK	Data that is a result of Performance Planning that can effect Strategic Planning.
PLANNING INFORMATION	The information and data (including operational planning feedback, operational information, external feedback, all communications from customers and other DPUs) used in the development of specific plans, programs and budgets and in the execution and assessment of those plans.
PLANNING, PROGRAMS, & BUDGETS	This arrow is a composite of specific guidance, planning information, strategic plans, specific programs and specific budgets from the Phase I To-Be Model.

PROMOTION MATERIAL AND INFORMATION	Material used by the Performance Engineering group to promote their products and services. It is also information about these products and services.
RECOMMENDED CORRECTIONS AND FEEDBACK	Recommendations for responding to exceptions (deficiencies and problems), based upon Selected Evaluation Results during the assessment of performance, as well as any general feedback such as observations, comments, and insights.
RESOURCE CONFIGURATION CHANGE	A change to the resources on which the Work Time Factors and Total Manpower Factors are based.
RESOURCE REQUIREMENTS	The total resources (manpower, equipment, material, facilities, funds, etc.) needed to accomplish a particular workload of a particular DPU under given restraints.
SELECTED ANALYSIS RESULTS	Performance results that have been monitored, analyzed, and selected for evaluation in the performance assessment process.
SELECTED EVALUATION RESULTS	Performance results that have been monitored, analyzed, evaluated and selected for use in recommending corrections to deficiencies in performance and providing other feedback.
SELECTED PERFORMANCE RESULTS	Performance results that have been monitored and selected for analyzing in the performance assessment process.
SPECIFIC BUDGETS	Budgets prepared by and for a particular DPU to carry out its performance responsibilities.
SPECIFIC GUIDANCE	Information, references, purpose, scope, applicability, definitions, policies, procedures, laws , regulations, responsibilities, etc. along with related implementing directives, instructions, manuals, and handbooks prepared by a Defense Performance Unit for its own performance.
SPECIFIC PROGRAMS	A special subject matter focus or grouping of activities for a limited purpose and/or time - prepared by or for a DPU.

STRATEGIC PLAN	The vision, mission, guiding principles, values, performance strategies, goals, objectives, , and related implementing plans (all the long range plans, a la GPRA) prepared by a particular Defense Performance Unit for its own performance. This is a broader, higher level and longer range plan than the more specific, shorter range, tactical performance plan. This plan contains a description and amount of the workload for a DPU.
TOTAL MANPOWER FACTOR	The target number and type of manpower resources needed to accomplish a general workload for a given time for defined unit of work within an organizational entity, accompanied by documentation of the method/technique used to develop the target manpower value.
TOTAL MANPOWER REQUIREMENT	The estimated total number of manpower needed by an organizational entity to accomplish its assigned workload (mission).
WBS & TASKING CODES	The Macro and Micro Work Breakdown Structure and Tasking Codes.
WBS & TC	The Macro and Micro Work Breakdown Structure and Tasking Codes.
WORK COUNTS	The units of output and their quantity for a given unit of work for which time is being established.
WORK DESCRIPTION	The decomposition of units of work with appropriate descriptive information of processes, procedures, resources used, conditions, etc. to permit the development of time and manpower factors.. The decomposition is the level of detail required to meet the need for effective and efficient management of the work.
WORK MEASUREMENT PLAN	The plan, developed in consultation with mangers, for the development of work standards for an identified area of work.
WORK STANDARDS	A statement of the processes, time and manpower needed to execute a given unit of work.
WORK STANDARDS UPDATE	Changes to any aspect of a Work Standard and/or proposed new Work Standards.
WORK TIME FACTORS	The target time required to accomplish a defined unit of work by a trained average worker under average or specified conditions, with documentation of the method/technique used to develop the target time value.

| WORK TIMES | The time required to produce a given work count for a unit of work. This is one of the factors (WT) in the Standard Time equation. |
| WORKERS | Personnel who have experience in the processes under consideration. Usually these are people currently engaged in the operational process. |

ACTIVITY NAME	ACTIVITY DEFINITION
ANALYZE PERFORMANCE	This activity analyzes the monitored performance results particularly situations of exceptions to determine what is actually happening in the execution of operational plans. The main focus is to provide a clearer understanding of actual or projected areas of deficiencies exceptions to the plans or problems. Conducting variance analysis is a particular activity within Analyze Performance. For PE, variance analysis is performed on work standards.
ASSESS PERFORMANCE	This is the process of assessing the actual performance results which were produced by executing operational plans. This is done by monitoring performance (observing and measuring the actual results and comparing these to the operational plans) analyzing the performance, evaluating the performance, and providing feedback and recommendations for dealing with exceptions and problems or for otherwise attaining the desired performance results.
CREATE PERFORMANCE PLAN	The activity of developing a tactical, shorter range (one year or less) plan to accomplish a given workload. It involves determining what work will be done, how to do it and what resources will be needed. These are pulled together into a total performance instrument to provide authority and instructions for executing the work, including performance linkages.
DEPLOY OPERATIONS IMPROVEMENT	This activity of deploying the validated improvements into full operation in all sites and/or aspects of the DPU. It involves developing plans, budgets and schedules for deployment; procuring the necessary resources; training/educating personnel in new processes, skills and procedures; building , setting up and/or installing new facilities or equipment; implementing new rules, regulations, procedures and/or policy; enabling cultural changes; and closely coordinating and overseeing all aspects of deployment.
DESCRIBE UNITS OF WORK	This activity supports the development of the Work Time Factors and/or the Total Manpower Factors by identifying, describing and analyzing the units of work that are to be measured for time and manpower. This activity may also discover and make recommendations for process improvements

DESIGN OPERATIONS IMPROVEMENT	This the activity of analyzing the focus area for improvement, identifying the problem(s), recommending improvements and defining improvement alternatives, analyzing and evaluating the alternatives, and identifying preliminary requirements for implementation.
DESIGN PERFORMANCE PROGRAMS	This is the activity of developing formal programs of work -- basically the POM process.
DETERMINE HOW WE WILL DO THE WORK	This activity refines the high level functions to lower level tasks to accomplish the mission, defines the tasks, and assigns appropriate tasking codes, i.e. How the functions will be done by the DPU.
DETERMINE RESOURCES NEEDED TO DO THE WORK	This is the activity of matching workload with the functions and determining what resources will be needed to accomplish each function's workload.
DETERMINE THE WORK WE NEED TO DO	This activity identifies and defines the high level functions to accomplish the mission, and assigns appropriate tasking codes, i.e. WHAT is the work to be done by a DPU.
DEVELOP OPERATIONAL PLAN	This is the process of planning for the operations of a Defense Performance Unit. Based upon the general plans, programs, budgets and guidance provided, strategic plans are developed, performance plans are created, performance programs are designed, and performance budgets are prepared -- specifically by and for a Defense Performance Unit.
DEVELOP STRATEGIC PLAN	This is the activity of building a longer range plan for accomplishing a given workload/mission.
DEVELOP TOTAL MANPOWER FACTOR	For each Work Description (WBS/TC) and related Time Factor, this activity determines the number of people (military, civilian, and others) needed to perform the work. This activity also documents the method used to determine this factor.
DEVELOP WORK STANDARDS	This activity describes and analyzes the unit of work to be measured, then determines the time factor and the total manpower factor for each unit of work.
DEVELOP WORK TIME FACTORS	For each Work Description (WBS/TC), this activity determines the time needed to perform the work. This activity also documents the method used to determine this factor.

DOCUMENT RESOURCE REQUIREMENTS	This activity documents the manpower and non-manpower requirements for the workload. This documentation includes the audit trail of how the data was determined.
DOCUMENT RESULTS (ST = WC/WTxM+A)	This activity completes the development of the Work Time Factor by compiling the elements of the Work Time Factor formula ("ST = C/WT*M+A") to determine the standard time (ST), i.e. the time factor coefficient. This activity also develops the audit trail which is included with the result, showing how the result was achieved.
ENHANCE PERFORMANCE	This is the process of making necessary improvements so that the Defense Performance Unit can meet or improve its planned performance results. This process carefully plans the improvement effort, designs the improvement, validates the improvement, deploys the improvement and constantly oversees the whole improvement project. An improvement effort may be a small simple effort done quickly or it may be a large complex many-faceted project lasting two to three years.
ESTIMATE OTHER RESOURCE REQUIREMENTS	This activity uses Work Standards, workload, and other plans to estimate non-manpower resources required to accomplish the workload, e.g. equipment, materials, supplies, facilities, etc..
ESTIMATE STAFFING REQUIREMENTS	This activity uses Work Standards, workload, and plans to develop the manpower requirements to accomplish the workload.
EVALUATE PERFORMANCE	Based upon selected results of the analysis this activity evaluates (makes interpretive judgments about) the performance resulting from executing operational plans.
EXECUTE OPERATIONAL PLANS	This is the process of executing the planned operations to produce the desired products and services (performance expectations). These operations are performed according to the tasking requirements and other guidance provided in the operational plans.
EXPAND PE SERVICES	This activity increases the depth, breath, and proficiency of services to be delivered. This applies to enhancing existing services as well as to the development of additional services. As the research and development dynamic of DPES, existing methods and techniques are refined and expanded, new methods and techniques are researched, developed and tested, and new packages of services are made available for marketing.

MANAGE ASSESSMENT	This is the activity of planning for performance assessment and overall management of the assessment process. Based upon performance expectations in particular and all operational plans in general this is the process of determining the particular requirements for monitoring analyzing and evaluating performance results.
MANAGE PERFORMANCE (SUPPORT)	This is a particular expression of the model "Manage Performance" with emphasis on Performance Engineering Support for the whole management cycle of planning, executing, assessing and enhancing performance. This is the process of determining desired performance results and the effort required to attain these results plus the support provided by performance engineering toward these ends.
MANAGE PERFORMANCE ENGINEERING	This activity plans and assess the efforts to provide PE support and services to the various processes of managing performance. In response to requests or requirements for services to management, PE personnel meet and plan with mangers as to the type and level of work and management to be addressed, as to the type of time/manpower factors and method of development that are most appropriate (value added) for the level of work and management required, and/or as to the type of assessment.
MANAGE PERFORMANCE ENHANCEMENTS	This activity plans an improvement effort by identifying the area of focus determining the approach methods and tools to be used creating budgets and schedules and assigning resources. This process continually updates plans and provides various kinds of guidance based on developments in the enhancement activities; authorizes next steps; coordinates the various components of improvement; and is a "court of appeal" for differences which arise in the improvement project.
MANAGE PLANNING	This is the activity of preparing for and coordinating the planning activities. It gathers, receives and distributes information relative to the planning processes. It also coordinates communication with other DPUs.

MONITOR PERFORMANCE	This is the on-going activity of observing and measuring performance results according to the monitoring requirements (particularly, according to the planned performance results/expectations, goals and their measures). This is the process of noting, objectively, the actual results of performance according to the determined criteria. The primary concern here is to identify deficiencies and exceptions to the plan and/or desired results.
OVERSEE ENHANCEMENT PROJECTS	This the process of providing quality assurance for improvement project products and ensuring that the improvement project complies with established plans and procedures. It receives, reviews, evaluates and approves/disapproves all the products of the improvement effort. Based on this, evaluations, recommendations and all other feedback are made to project management and other project activities.
PREPARE PERFORMANCE BUDGETS	Any and all activities involved in preparing budgets - long term, short term, proposed or current operational, for carrying out its performance responsibilities. This is basically the PPBS process.
PREPARE PERFORMANCE PLAN	This activity uses the projected workloads and resource estimates in developing a plan to accomplish the workload. This is a shorter range (year, quarterly, monthly, etc.), tactical plan.
PROMOTE PERFORMANCE ENGINEERING	This is the activity of packaging and marketing the services of PE. It also involves efforts to inform and educate management as to the nature and uses of PE capabilities and their benefits to performance management. This activity also seeks to promote management by results and the importance of establishing and maintaining linkage of workload, manpower, money, and time at and between all management levels and between all management levels.
PROVIDE PE DATA SUPPORT	This activity manages the automated support for PE. This includes developing time and manpower factors, and maintaining data repositories of existing WBSs, time factors, manpower factors. Applications for developing maintaining, and promoting time and manpower factors, performance management systems for planning, execution and assessment are promoted, and interface between time and manpower factor databases/systems and the performance management systems are developed/promoted.

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PROVIDE PERFORMANCE ENGINEERING SUPPORT	The primary function of this activity is to develop work standards (process, time and manpower) for accomplishing workloads efficiently and effectively. It also provides services which support and assist management in planning decisions (all levels, types and phases) through the use of work standards, in assessing workload performance results against performance plans, and in enhancing performance through methods and tools of work analysis and work process improvement.
RECOMMEND CHANGES	In light of selected performance evaluations this is the activity of making recommendations for corrective actions in response to deficiencies exceptions problems etc. These recommendations along with other types of feedback (comments insights observations etc.) are provided to the planning and execution processes.
SPECIFY ALLOWANCES (A)	This activity supports the development of the Work Time Factor by specifying the allowances portion of the Work time Factor Formula. This equates to "A" in the Work Time Factor formula.
SPECIFY RATINGS (M)	This activity supports the development of the Work Time Factor by specifying the ratings portion of the Work time Factor Formula. This equates to "M" in the Work Time Factor formula.
SPECIFY UNITS OF INPUT (WT)	This activity supports the development of the Work Time Factor by specifying the "work time" used performing a unit of work. This equates to "WT" in the Work Time Factor formula.
SPECIFY UNITS OF OUTPUT (WC)	This activity supports the development of the Work Time Factor by counting number of products/services produced by the unit of work ("work count") during the specified "work time". This equates to "WC" in the Work Time Factor formula.
VALIDATE OPERATIONS IMPROVEMENT	Beginning with the authorized design package this process develops, tests, and evaluates the improvement. When the improvement is ready for deployment into all operations plans and recommendations for deployment are prepared for approval.

APPENDIX D - TECHNIQUES DEFINITIONS

D.1. PROCESS RELATED

D.1.1 Possibility Guides

This involves the creation of a guide the includes three parts. First part, would be the selection of successful solutions that will identify the maximum financial advantage as well as the maximum conformance with external imposed restrictions. The second part involves making a rough determination of the degree of change that is warranted. The third part would be the contemplation of the apparently feasible areas of change and the selection of the most feasible area of change. The guide that is produced should include a list of the suggestions as well as the possibility list which would detail the consequences of each attractive suggestions.

D.1.2 Work Unit Analysis

The delineation of the outputs of an organization and the outputs, in work-unit terms. It can be used to provide a framework for identifying outputs and groups of outputs and to assist in developing a method for counting the outputs. This technique is a necessary preliminary step used prior to the application of techniques for improving the method of producing the outputs and measuring the staff resources required to produce them.

D.1.3 Work Activity Analysis and Work Sampling

Work Activity Analysis is a chronological record, usually accompanied by a summary tabulation, of the nature of the activities performed, work-units produced, and the time spent at each activity by an individual performing a variety of tasks. Work Sampling consists of a large number of observations taken at random or other designated intervals. In taking the observations, the state or condition of the object of study is noted, and this state is classified into predefined categories of activity pertinent to the particular work situation. The ratio or percentage of observations recorded in a given state tends to measure the average percentage of time in that state. The number of observations depends on how accurate the answers need to be. A larger number of observations provides a greater accuracy. This technique is used to determine how much time is taken up by each type of task, so as to guide efforts to improve those tasks where the return will compensate for the effort. This techniques is also used because almost every organization has jobs which appear, to have no cycle or repetitive pattern. These jobs are in the indirect labor or white collar areas. These jobs tend to require an identification and a sorting out of the elements of repetitive before the more classical techniques of motion study can be applied. Work sampling and work activity analysis may involve the handling of much numerical data and therefore the PCs are depended upon greatly for this technique.

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D.1.4 Process Chart-Product Analysis

Constructed from an actual observation of the process and is a graphic means of portraying (or a schematic model of) the separable steps of the procedure, applied to the product required to modify the output from one stage of completion to another. It is used to verify the necessity of doing a particular job in the sequence before attempting to improve it.

D.1.5 Horizontal Time Bar Charts

A graphic measure of portraying the time relationships among the separate steps of the procedure involved in performing the work required to modify an output from one stage of completion to another.

D.1.6 Network Diagrams

When a process involves a complex system of dependencies, and these dependencies are tangled and do not progress in a uniform fashion, some other system of charting is required to assist in analysis. Network diagramming includes symbols such as circles and squares, where each symbol of the diagram represents a status achieved by the performance of activities. A status is a partial or complete service or substantive output completed. This technique is used with such complex projects of the type that have been described, an analysis technique employing a network diagram has been shown to be of great value in developing an effective process design. A network diagram is a graphic method of displaying the relationships among the steps in a process.

D.1.7 Process Chart-Person Analysis

A graphic means of portraying the separable steps that a person performs when doing a task that requires the person to move from place to place in the course of work. This technique is used when some jobs or work stations are of such a nature that a considerable area is covered by the work of an individual. Of this nature are many of the jobs of maintenance and service employees, machine tenders, material handlers, warehouse employees, etc. A process chart- person analysis is an analysis of what the person does, and not of the steps performed in sequence on the product or material. The chart is an aid to clear understanding of the activities of persons performing work that requires them to move from place to place.

D.1.8 Information Flow Analysis

This technique deals with the communication issues, interaction with the human factors and on improving the information flow systems. This technique includes the following parts: functional forms that really are tables representative of the activities; Process chart-combined analysis when the work involves more than one workstation; and Forms and formats design procedures which involve designing effective forms and formats and improving existing one.

D.1.9 Operation Charts and Robot Analysis

A graphic means of portraying the separable steps of a person's body members when a job is being performed that takes place essentially at one location. It is a schematic model of the method.

D.1.10 Multiple-Activity Charts

A graphic means of portraying the separable steps performed by a worker and a machine, or several workers with or without machines, or a robot and one more machines, in a manner such that coordination of the subject charted is also displayed. A multiple-activity chart is made usually to obtain better utilization of the machine or the worker (or workers). The chart aids in the determination of the most effective way of harmonizing the work of each individual with the group or with the machine. It may also be used to indicate how the machine might be altered to harmonize with the requirements of the individuals.

D.1.11 Quality Control

The quality of a product or of a service is the combination of characteristics, properties, or attributes that govern its suitability for its intended purpose. Hence, each product has its own requirements. This techniques involves inspections, in-process controls, and automated inspections to ensure the desired quality is obtained for a product or service.

D.1.12 Photographic and Electronic Data Recording Aids

This technique involves the use of these aids which assist by recording data from real-time events and holding the information in a way that permits either its transaction into a form or its presentation in a form serving the purpose of analysis.

D.1.13 Micromotion and Memomotion Analysis

Mircomotion analysis is a detailed recording of the motions involved in performing a job. The activities of the hands (and other body members as may be desired) are usually recorded in terms of 17 separate categories. Memomotion analysis was the name originally give to studies having the use of motion pictures taken at unusually slow speeds, such as 50, 60, 100 frames per minute, which among other things conserved the use of expensive film. Like all tape study, it is merely another means of performing the second step of scientific method analysis and requires three phases: recording, analysis, and graphic presentation.

D.2. TIME RELATED

D.2.1 Direct Time Study - Intense Sampling

A procedure in which the performance of a task is observed directly and continuously for a limited period of time. Data are recorded concerning the work time and the associated work count, together with an appraisal of the performance in comparison with the concept of standard performance. An allowance for non-work time and nonproductive interruptions is usually added in conformance with actual events and policies that have been

established by the organization. All these data are used in the computation of a standard time.

D.2.2 Direct Time Study - Extensive Sampling

A procedure for setting standard times wherein the observations are made, as with work sampling, at intervals (rather than continuously) over an extensive period. Each observation, as with work sampling, is classified into a category. However, the categories other than idle, rest and so forth, are the second-, third-, or fourth-order work-units associated with the activity observed.

D.2.3 Develop Skill at Rating Time Studies

It should be obvious that no matter what method of rating is used, skill at rating must be developed. To ascertain whether skill is being developed or maintained, periodic testing is necessary. Starting a training program is an element of this technique along with periodic testing and training sessions.

D.2.4 Predetermined Time Systems (PTS)

A set of organized data for first-order work-unit standard times, representing some consistent and known concept of standard performance, together with the rules and conventions for computing and documenting a task standard time from these data. The application of a predetermined time study system results in a "predetermined time standard".

D.2.5 Standard Data Systems

The use of databases, using 3rd and 4th order work-unit time values, for setting standard times. The sources of the data, in addition to the source used with standard elemental data systems, may include the use of standard elemental data itself.

D.2.6 Computer-Assisted Standard Times

The major thrust of general computerization in the are of work measurement has been use of the computer to store and manipulate the work measurement data. This creates automation of the work measurement system. Automation of the work measurement systems increases the ability of engineers to review data, but it does not guarantee the flexibility required to extend the measurement data to new products or processes. There are three general types of assistance that computer can provide to work measurement, as follow: Computer processing of work measurement data that is observed and recorded in the usual manner; the subsequent processing of the data is controlled by a computer program; An electronic data gathering device is used to collect the work measurement data. As with type 1 the subsequent processing of the data is controlled by a computer program; A computer is used to seek work-unit data in a previously prepared database, without work-time observations of the job being studied, and synthesize a standard time for the job.

D.2.7 Fractionated Professional Estimate

A standard time set by one or more individuals, knowledge in the subject matter of the work-unit (or work-units), who list the components of the work-unit as a first step. The listing must be in discrete, homogenous (described under a single action verb) steps that are sufficiently small so that an estimate of the time required to perform each separate step may be made with reasonable accuracy, but of a size appropriate to the scope of the job.

D.2.8 Time Standards by Fiat

A time standard by fiat is one that is implicit in the design criteria used to design the work-unit or output. (The word fiat is used to indicate that the standard is by decree.) This is the simplest type of work measurement. Of course, it is not always applicable.

D.2.9 Time Standards by Mathematical Analysis

Statistical data, obtained over a period of time concerning the production of outputs and the use of staff resources, is subjected to mathematical analysis to determine the relationship between required staff resources and outputs. The result is a standard derived by mathematical analysis. The necessary data may be available, in some cases, from existing records; in other cases, special data collection systems need to be designed and used.

D.3. MANPOWER RELATED

The following techniques are examples of the many techniques used by Army, Navy and Air Force in determining manpower requirements. Most of these techniques employ one or more of the above techniques in one form or another or in combinations. No descriptions were found for the techniques which were listed in various briefings and manuals. The list is as follows:

- Operation Audits
- Ratio Models
- Incremental
- Algebraic
- Directed Requirement
- Pure Positional
- Composite Workload
- Modeled
- Purely Workload
- MS-3/staffing guide
- Project/Throughput

APPENDIX E - COMMERCIALLY AVAILABLE WORK MEASUREMENT SOFTWARE

E.1. INTRODUCTION

E.1.1 Objective

Section 4 discussed the use of **COTS** as a theoretical part of the WSAP toolbox/solution, both for the front end suite of work analysis and measurement tools as well as for developing and maintaining work standards. Appendix E documents the efforts to identify and review COTS products that support automated industrial engineering techniques, particularly work measurement and work standards development. The analysis will cross reference the COTS products to the general functional requirements for the WSAP system and to the basic work measurement techniques described by Marvin Mundel in the 7th edition of his book <u>Motion and Time Study</u>.

E.1.2 WSAP Requirements

The WSAP general functional requirements are listed in section 4.3.2 of this document. Those paragraphs have been reviewed and the requirements extracted. The requirements are separated into four sets of numbered lists: Work Processes (WP), Target Time (TT), Total Manpower (TM), and General Capabilities (GC). The requirements are referenced by a two letter designator of their category plus a number as an item of that category, e.g., WP01 is Work Process requirement number 01.

E.1.2.1 Work Processes Requirements (WP)

1. To identify units of work (functions, activities, processes, tasks, jobs, methods, motions, procedures and/or flow of work) to accomplish a workload -- both in general and for specific DPUs;

2. To identify and measure products/services produced by each unit of work and/or other workload definitions;

3. To roll-up these units of work properly (that is, without duplication or loss of component work and their associated factors);

4. To associate both historic and projected performance data (products/services produced along with time and manpower resources used in producing these results) with these units of work in order to conduct analysis and/or alternative "what if" scenarios in support of deciding the most effective and efficient way to accomplish a workload;

5. To contribute information to and/or receive information from performance improvement programs/tasks (e.g., MOE, ER, BPR, FPI, ABC, PECI, TQL/M, etc.);

6. To maintain and update WBS and unit of work descriptions; and

7. To make available predetermined work breakdown structures (WBS) and descriptions, generic or general WBS and/or results from analysis of similar work, along with the ability to "pick-n-plug" in developing a WBS and description for a particular DPU or project under consideration.

E.1.2.2 Target Time (TT)

1. Supporting the determination and recording of all of the factors in the standard time equation (ST=WT/WC*M+A) for the units of work previously described (both for detail steps as well as larger, more general units of work, both for 'touch labor' as well as 'white color' labor, both in general and for specific DPUs);

2. Documenting work flow with cycle time, lapse times, operation time, etc.;

3. Analyzing and performing "what if" scenarios;

4. Properly rolling-up of times into larger units of work;

5. Making available predetermined times, generic/general times and/or times from analysis of similar work;

6. Providing commonality between the development of time factors and development of manpower factors when the determination of one is related to the determination of the other; and

7. Maintaining and updating time factors.

E.1.2.3 Total Manpower (TM)

1. Record all the types of manpower (military, civilian, contractor, other) targeted to be used in accomplishing the workload of a unit of work;

2. Automate operational audits, and other numerous techniques for determining the work components, manpower and time required to perform a process;

3. Document the results of the numerous techniques and methods used for determining the manpower needed to accomplish units of work-- that is, for linking people to work;

4. Record various factors of staffing formulas and make the calculations used in determining manpower needed;

5. Identify, develop and maintain standard ratios of direct and in-direct (support) for units of work;

6. Access generic/general manpower factors and/or manpower factors from analysis of similar work along with the ability to "pick-n-plug" in applying to particular DPUs;

7. Establish programmable relationships between units of work, workload and manpower needed;

8. Properly roll-up manpower factors into higher units of work; and Maintain and update total force manpower factors.

E.1.2.4 General Capabilities (GC)

1. Support for developing service-wide generic/general work standards as well as functional/work center specific work standards;

2. Interface with management systems to provide WBS codes, time factors and total force manpower factors; and

3. Interface with management systems to obtain historic/actual data on units of work as to output and the time and manpower resources expended for that output .

E.2. DATA COLLECTION

The major time requirement for this type of review, analysis and evaluation is for searching out products and collecting data about them. The limited time allotted for this task and the high level nature of the functional requirements both dictated a high level review of COTS products. As such there was no attempt to obtain evaluation copies of the products for "hands-on" testing and evaluation. Instead, the data collection was focused on marketing and technical documentation for each of the products. This data was supplemented where possible by phone conversations with the product vender and functional users of the product.

E.2.1 Data Sources and Methods

The search for information was not exhaustive, but a good cross section of resources were reviewed. Our starting point was the functional experts. Some locations were using COTS to help them do their works, but most were not. Available Industrial and Management Engineering journals were searched for and reviewed. The best journal located was the "Institute Of Industrial Engineers" journal IIE Solutions. The World-Wide-Wed was reviewed for Industrial and Management Engineering related sites. The majority of sites found were for University Industrial Engineering offices. These sites primarily promoted the degree programs at the university and were not particularly helpful in identifying COTS packages. Searches were also performed on "Industrial Engineering", "Management Engineering", "Labor Standard", "Staffing Standards", "Manpower", "Work Measurement", "Job Definition", "Job Costing", and like phrases.

E.2.2 COTS Packages Reviewed

As a result of these search efforts, the following COTS packages were identified and reviewed. The support provided by the COTS packages vary in the breadth of their coverage. Some packages are very narrow and cover a single topic while other are very wide and represent a more complete system. There are packages that support classical work measurement with analysts observing the work and recording actions and associated times. There are packages that support video taping operations and conducting the work measurement, and process and motion analysis based on the video. There are packages that allows analyst to define work process using predefined time codes. There are systems that allows analysts to describe a process in a textual language that is translated into predefined time code or directly into a time unit. There are packages that support work sampling, complete process definition, line layout, work station layout, and line balancing. There are packages to support ergometric analysis of the work operations. There is one package that supported an entire manufacturing process. However it did not

support standards time development for operations, but did have a place to use the numbers once developed.

Company: Applied Computer Services, Inc.
                7900 E. Union Ave. Suite 1100
                Denver, CO 80237

POC: Douglas G. Aird
                (303) 220-0138

Product: The Resource Planner

Description: The Key to the Resource Planner is that it does not lock users into any particular measuring technique. It supports all predetermined time systems as well as time study and work sampling. These latter two methods use an integrated hand held device to assist in collecting data. The Resource Planner applications are configured by users to meet their exact needs (i.e., fields, field size, worksheets, supporting forms and calculations).

Capabilities of the Resource Planner include:

1. Strict Revision Control
2. Detailed Work Instructions
3. Process Change History
4. Floor Control
5. Planning Support
6. Industry Specific "Experts"
7. Full Estimating System.

With Expert Modules, current DoD users have been able to load existing data into the Resource Planner and make it easily accessible.

The Resource Planner is currently used at Cherry Point Navy Depot and a task force from NAVAIR has scheduled a March 1997 visit to ACS to overview current and future capabilities of the Resource Planner.

Comments: The Resource Planner experts support documenting work with up to 20 levels of detail. The primary goal of the Resource Planner is to build work instructions by picking items of work from the expert decision tree. Once developed, the work instructions are configuration managed.

The Resource planner did not seem as straight forward as some of the other packages that build standards. The data and demo provided discussed the use of the "Expert Decision Tree" to select "tasks" to add to a "worksheet" for analysis. There was no data provided on how an "Expert Module" is developed or how the set-up and run times are determined. The documentation says that "All popular techniques including picksheets, predetermined times, in-house data ,time study and work sampling are supported." It does not indicate if there is a method support or if it will just take a value determined by an analyst using other tools and techniques.

The brochure and demo briefing show the assignment of tasks to work centers and mentions the ability of the Resource Planner to do line balancing. I could not see how this was really supported.

I could not determine if The Resource Planner supported a hierarchical process decomposition. The "Expert Module" supports 20 levels, but it does not define that a process is decomposed at each level. The screen representations show that the lowest level actions are typically grouped by categories and not operations. For the lowest level action data is held for the Usage/Unit, Work Center Number, Set up Hours, and Run Hours. An expert decision tree shown in the documentation is illustrated below.
Boards
> Mother
>> 386 DX/25
>>> Assembly

Selecting this tree path resulted in putting a single step in a work instruction. Some additional insight on the development of an expert decision tree and the data assigned at the lowest level activity would be helpful.

DO-0121   24 March 1997

Company: Sew-ware Systems, Inc.
              4681 Wycliff Ct.
              Concord, NC 28027
              (704) 782-6041
              rberger@acquion.com
              http://www.best.com/~lidial/swew.htm

POC: Roy S. Bergen

Product: C.A.T.S...."Computer Assisted Time Studies"

Description: A group of PC/DOS computer programs which provide a tool for today's
              Industrial Engineer to save about 95% of the Engineer's clerical time
              used to calculate results and produce reports from the collected data.
              This product has automated Traditional Time Study (collecting process
              and time data by observation and performing needed calculations and
              report generation) and will perform all of the clerical and mathematical
              steps. It also provides multiple stop watches for the timing algorithms. It
              then places the study into a C.A.T.S. database for further analysis. This
              provides a win-win situation as the cost justification and pay back are
              within only weeks in most instances.

Comments: The C.A.T.S is just what the title says, a computer assisted time study.
              It is used to help in setting up the time study, collecting data during the
              time study, calculating needed values from the record data, and
              generating reports. The real selling point of the application is the post
              study calculation needed values from the record data, and development
              of reports based on data collected.
              See: "The RateSetter" and TIMSTUDY.

DO-0121   24 March 1997

Company: Lilly Software Associates, Inc.
               239 Drakeside Road
               Hampton, NH 03842
               (603) 926-9696 -- voice
               http://www.cadcam/visual/visual.htm

POC: Anthony "Skip" Casamatta
               2115 Front Street
               Cuyahoga Falls, OH 44221
               (330) 929-0600

Product: Visual Manufacturing

Description: Visual Manufacturing is a full featured application that provides quick
                  access to graphical representation of the status of operations to assist in
                  the management of a manufacturing organization. Its Client/Server
                  technology running on Novel; NetWare or Window NT allows for
                  communications and growth. Its SQL Relational Databases (SQLBase or
                  Oracle) provide rapid data access and management. Its Windows based
                  graphical interface provides for easy use and outstanding visability into
                  plant operations. Visual Manufacturing consist of the following "System
                  Modules":

Foundation Modules
- VISUAL Job Status manager
- Job Costing
- Estimating
- Scheduling
- Purchasing
- Multi-Currency
- Engineering & Job Definition
- Shop Floor Control
- Order Entry
- Invoices
- Inventory

Optional Modules
- MRP and MPS
- Traceability
  (Lot and Serial Number Control)
- Product Configurator (Parametric)
- SPC (Quality)
- Engineering Change Control
- General Ledger
- Accounts Receivable
- Human Resources
- Bar Coding
- Product Configurator
  (Rules Based)
- EDI
- Statistical Sales Forecasting
- Dimensional Inventory
- Accounts Payable
- Payroll

Comments: Visual manufacturing looks to be a very nice 'cradle to grave' information
                system for manufacturing. Visual Manufacturing does not help develop
                time standards but it could be interfaced (via OLE) to a Time Standards
                development product. A key here is that Visual Manufacturing uses the
                job definition activity hierarchies to manage production. My first
                impression is that Visual Manufacturing with Time Standard interfaces
                could serve as a "Standard" system for DoD.

DO-0121   24 March 1997

Company: FAEHR Electronic Timers Inc.
                1836 Teckny Court
                Northbrook, IL 60052
                (847) 272-9799

POC: Clifford Sellie, P.E.
                President & Technical Advisor

Product: The "RateSetter" System

Description: FAEHR offers three Work Measurement timing devices and the
                "RateSetter" system. Two of the timing devices are special clipboards
                with built in digital timers, and the third is a hand held or clip board
                mountable timer that supports cumulative and Snap/Back modes of
                operation. The "RateSetter" system includes a specialized clipboard that
                supports the recording of process steps and associated time for each
                process step. After a time study is complete, the data held in the
                clipboard device can be downloaded to a PC for processing by the
                "RateSetter" software, and appropriate reports developed. The
                "RateSetter" software does not feed the clipboard any process structure.
                The process structure is always entered on the clipboard for each time
                study.

                FAEHR also offers "Productivity Improvement Video Cassettes" and
                educational booklets for supervisors, employees, and staff.

Comments: The "RateSetter" software does not feed the clipboard any process
                structure. The process structure is always entered on the clipboard for
                each time study.
                See: C.A.T.S., and TIMSTUDY.

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Company: Industrial Engineering Services
                 2400 E. Rock Creek Road
                 New Bern, NC 28560
                 (919) 637-2471

POC: Walter W. Erwin, P.E.
                 President

Method: MODAPTS®

Description: MODAPTS® is a MIL-STD 1567A compliant third generation
                 predetermined time system used for:

1. Calculating reliable production standards
2. Improving an organization's productivity
3. Analyzing department efficiency
4. Determining pre-production costs
5. Improving employee relations

MODAPTS® is a method which supports the definition of tasks into a sequence of coded motions for a well trained motivated employee. Each motion has a predefined time value used to determine the Target Time for the task. MODAPTS® is supported by a multi-level DOS application called CAESAR™, and Windows™ based applications Time Quest Study Taker and Time Quest Data Manager.

Comments: MODAPTS is a predetermined time system that uses codes to define work. The application looked good and the predetermined time systems will support investigating alternate ways to perform a work process. See MOST and Ease.

Product: Time Quest Study Taker

Description: StudyTaker is designed for you to take an on-floor MODAPTS® study using a notebook computer. Once your floor study is completed you may then construct standard data for entry into your TimeQuest DataManager software.

Comments: This is similar to C.A.T.S., "The Rate Setter", and TIMSTUDY, but MODAPTS codes are being used as opposed to times.

Product: Time Quest Data Manager

Description: Data manager is designed to complement the data collection software StudyTaker. Once a floor study has been completed the resulting data is entered into DataManager. StudyTaker is intended to run on a notebook computer while DataManager runs on a desktop.

DataManager is for the engineer responsible for developing labor standards, costing new or existing products, and who is involved with improving plant productivity. Because DataManager allows you to attach data to graphical images, personnel outside the engineering department

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will also find DataManager useful. For building data, DataManager uses the popular predetermined time system called MODAPTS®, Modular Arrangement of Predetermined Time Standards.

Elements are used to create Modules, Modules to create Operations, Operations to create Subassemblies, and Subassemblies to create Assemblies.

Comments: Time Quest Data Manager looks to be the package that takes the MODAPTS data collected and utilize it in a production environment. It supports identifying plants in an organization including variables or differences in how the plants perform common tasks. Time Quest Data Manager also supports assigning a work center for each activity or operation in order to print production tickets and track work in process.

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Company: Spalding Software Inc.
               154 Technology Park, Suite 250
               Norcross, GA 30092
               (770) 449-0594

POC: Mr. Dick Hays
               President

Product: ProRep

Description: ProRep is a comprehensive IBM PC based productivity measurement
                 and reporting system that provides feedback about performance,
                 productivity, and quality. It is designed to provide the information
                 management needs to increase productivity, including information about
                 current results and how these results compare to past history.

                 ProRep calculates the performance of individuals by comparing the
                 results of each task they perform to the task's standard. ProRep can use
                 standards that are determined by any type of standards setting technique
                 such as time studies, predetermined time systems, or productivity goals
                 set by management. Daily production data can be input from production
                 sheets or via bar code scanning or ProRep can use existing data from
                 current computer systems. Quality measures can be included in the
                 databases of operational statistics. Therefore, user-defined reports and
                 graphs can include quality statistics for work centers, employees,
                 processes, and products.

Comments: ProRep is a management tool and not a standards development tool. It
                 uses developed standards to compare against actual data, providing
                 performance data for managing an organization.

Product: DataImport

Description: DataImport translates report or text files with any number of lines up to
                 2048 characters per line and outputs spreadsheet, database, text and
                 interchange files. DataImport also supports appending to existing
                 spreadsheets and databases and combining into spreadsheet files.

Comments: This product is not directly applicable to the scope of the survey and not
                 shown in the review tables.

DO-0121   24 March 1997

Company: H.B. Maynard and Co. Inc.
               8 Parkway Center
               Pittsburgh, PA 15220
               (412) 921-2400
               http://www.hbmaynard.com

POC: Edward J. Gill
               (412) 921-2400 Ext. 114

Product: AutoMOST™

Description: AutoMOST is an application that assists in the development of "Expert" systems. The "Knowledge Engineer" interviews process experts and uses AutoMOST's graphical user interface to develop decision trees. AutoMOST uses this data to generate the rule-base and associated "Expert System".

Possible AutoMOST applications include; developing Production and Maintenance Standards, Trouble-Shooting/Fault Isolation Systems, Cost Estimation Systems, Customer Service Systems, and Training systems. For Production and Maintenance Standards development AutoMOST includes built in capability to access the database in other Maynard applications.

Comments: Auto MOST could be used to define the activities for given operations and thus establish an activity standards. However, the true use of this tool is to develop "Expert" systems for use within an organization.

This product is not directly applicable to the scope of the survey and not shown in the review tables.

Product: MOST®

Description: MIL-STD-1567A. MOST for Windows supports the Maynard Operation Sequence Technique (MOST) including the Basic Mini and Maxi versions, make the measurement of work a practical, efficient, and inexpensive task for the industrial engineer.

MOST for Windows supports the layout of work areas and definition of work activities using the text based language MOST. MOST for Windows translates the MOST text into TMU operation times based on the layout of the work area and standard times assigned for each textural operation..

Comments: MOST for Windows looks like a good application for developing standards times from predetermined times. The predetermined time systems will support investigating alternate ways to perform a work process. MOST and EASE use similar functionality to develop work descriptions and time standards. See Ease and MODAPTS.

Product: MOST® Data Manager

Description: MOST® Data Manager software enables you to quickly and easily create time standards. Through automated and efficient standard data search and retrieval, mass update capabilities, and allowance application engineering performance is dramatically enhanced.

The MOST Data Manager software provides the ability to combine sub-operations, created in MOST for Windows , into operations and eventually into plans. At any time while creating or viewing the next higher level of data, the software allows you full access to search and view any of the lower levels of data. The ability to cascade through the various levels of data allows you to move from the highest level in the system all the way down to a basic method step, in a matter of seconds.

Customized titles or Header screens are available for all levels within the MOST Data Manager, with capability to search under any field in the Header.

The software also provides the capability to attach a specific title to a sub-operation or operation, but only as it appears in a given operation or plan. This feature controls the size of your database by allowing you to create generic standard data, yet still maintain specific detailed information in operations and plans. For example:

Sub--Operation Title: Assemble Small Part with 3 - 5 Rivets
Sub-Operation Title as it Appears in Operation: Assemble Part Number 656-A to Frame

ADDITIONAL FEATURES: Mass Update, History, Auxiliary Data, Automatically Applied Allowances, and Labor Performance Reports.

Comments: MOST Data Manager used the sub-operations defined in MOST for Windows and allowed them to be sequenced into Operations and the Operations into Projects (Routers).

Product: Assembly Manager™

Description: Assembly Manager is a Windows based software application that enables you to balance labor for production lines. Using assembly Manager, you can maximize utilization, while minimizing cycle time.

Comments: The Assemble Manager does line balancing. If you wanted to look at the assembly line as a larger activity, then minimizing the time and resources needed could imply a standard for the higher end process.

This product is not directly applicable to the scope of the survey and not shown in the review tables.

Product:	ErgoMOST

Description: ErgoMOST for Windows allows you to analyze ergonomic problems in the workplace by assessing the complete ergonomic picture through evaluation of job steps, jobs, and job rotations. Based on a biomechanical model, ErgoMOST calculates stress for pushes and pulls as well as lifts. Results include analysis of five ergonomic areas: force, posture, repetition, grip, and vibration.

Comments: This product is not directly applicable to the scope of the survey and not shown in the review tables.

DO-0121   24 March 1997

Company: Modern Management Inc.
                7421 Carmel Executive Park
                Charlotte, NC 28226
                (704) 365-8087

POC: Unknown

Product: MODCAM

Description: Maintenance Management software that includes a time standard
                module. Benchmarks are located in spreadsheets grouped by craft and
                task areas, so that maintenance work can be slotted and time standards
                applied.

Comments: Modern Management Inc. was contacted twice for data and each time an
                answering machine was reached and a message left. Modern
                Management Inc. did not return the calls or send any literature.

DO-0121

24 March 1997

Company: MTM Associates for Standards and Research
1422 Peterson Ave.
Park Ridge, IL 60068
(847) 299-1111

POC: Dirk J. Rauglas
Executive Director

Product: MTM-UAS

Description: MTM Universal Analysis System (UAS) is MIL-STD 1567A Compliant.

MTM-UAS represents a second generation of synthesized data based on the MTM-1 system. It was constructed through use of statistical analysis of basic MTM-1 motion patterns. The system is best suited for use in bath production with long cycle times (4 minutes or More). . MTM-UAS is eight times faster than MTM-1.

MTM-UAS provides the effective work measurement that management needs to improve scheduling, manpower planning, and employee relations as well as controlling costs.

While batch activities may not require the detail associated with high volume activities, the need for consistent accurate measurement is undiminished. It actually increases because accurate measurement of capacity is absolutely necessary for survival in the competitive international marketplace. Costing bidding, scheduling, and total system performance all suffer when inaccurate data is used.

MTM-UAS was developed to provide process description and to determine the allowed times in any activity having the characteristics of batch production. MTM-UAS is universally applicable to activities so long as the following typical batch characteristics are present; Similar Tasks, Work Places Designed for the Tasks, Good Levels of Work Organization, Detailed Instructions, Well Trained Operators.

Comments: MTM-UAS is not a Software Application, but rather a "Data Set" used by ADAM or MTM-LINK. A such MTM-UAS is not shown in the review tables.

Product: MTM-MEK

Description: MTM -MEK is MIL-STD 1567A compliant.

MTM-MEK, a third generation system based on statistical analysis of MTM-1 data, is designed for economical measurement of small lot or one-of-a-kind production, with long cycle times (21 minutes or more), as well as other infrequently performed tasks previously considered to costly or difficult to measure. MTM-MEK is noted for its speed which can be fifty or more times faster than MTM-1

MTM-MEK may be used to analyze all manual activities as long as the following characteristic requirements of a low methods level are met:

- The task is not highly repetitive or highly organized. the method used to perform a given operation will normally vary from cycle to cycle.

- The work place, tools and equipment used must be universal in character.

- The task being complex in nature requires a high degree of employee training, while the lack of a specific method to accomplish the task requires a high degree of versatility on the part of the operator.

Comments: MTM-MEK is not a software application, but rather a "Data Set" used by ADAM or MTM-LINK. A such MTM-MEK is not shown in the review tables.

Product: ADAM®

Description: ADAM® is a complete software system designed to create and maintain work standards for the non-manufacturing environment. The system provides for incorporating the MTM-UAS, MTM-C or use-supplied data sets, thus combining the power of the ADAM® software system with the accuracy and versatility of the MTM family of systems.

Comments: ADAM was developed to support development of staffing requirements by skill code for hospitals. After developing the work structure and assigning standard times, a workload can be applied to develop staffing requirements.

Product: MTM-LINK

Description: MTM-LINK is a complete software system designed to create and maintain work standards for the manufacturing environment. All current MTM work measurement systems can be loaded as modules to the MTM-LINK software to provide the user with the proven quality of the MTM family of work measurement systems. The MTM-LINK system will also accept data from any other source and apply the same broad selection of sophisticated data handling tools.

The MTM-LINK system facilitates the following basic functions:
    Elemental Time Development
    Operational Standard Time
    Routing Time Development
    Where Used and Mass Updating
    Maintenance of a Comprehensive Standards Database.

The MTM-LINK system augments the basic functions with many other highly advanced features, such as:
    Artificial Intelligence
    Standards history
    Line Balancing
    Mathematical Formula Application
    Pick Sheet Capability.

Comments: MTM-LINK was developed to support the manufacturing environment. After developing the work structure and assigning standard times, MTM-LINK supports the definition and balancing of the "Lines" and "Cells". Some measure of manpower planing is supported by MTM-Link through resource allocation.

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24 March 1997

Company: Triangle Research Collaborative Inc.
P.O. Box 12167
100 Park, Suite 115
Research Triangle Park, NC 27709
(919) 549-9093

POC: Thaddeus K. Szostak
President

Product: OCS TOOLS

Description: The Observational Coding System Tool set (OCS TOOLS) integrates software and hardware for observational data collection, editing, records management, and event analysis. OCS TOOLS improves the reliability and efficiency of observational data collection procedures.

Three basic systems (OCS-LIVE, OCS-FRAME, and OCS-VCR) are available to meet specific project needs. Each can be enhanced by a number of additional hardware and software options.

Comments: Basically an operation is videotaped and played back as controlled by OCS TOOLS. OCS TOOLS allows the users to enter event codes as the tape is stepped through and adjust codes as needed on additional reviews of the tape. All data is stored in the database and correlated to the video tape. Videos may be replayed with the event data overlaid on the video for review and presentation purposes. In live mode OCS TOOLS uses the computer's system clock to time operations as the user enters time codes based on observations.

Appropriate hardware is available from TRC. Inc.

Product: MAS TOOLS

Description: The Motion Analysis Tool set (MAS TOOLS) is a computer integrated video tool designed to analyze the motion of a videotaped subject. They provide a reliable and efficient means of motion data collection and analysis. MAS TOOLS will operate on IBM PC, XT, AT, PS/2 or 100% compatible machines. The user has a choice of coding methods (Paused and Continuous), ability to see an animated graphics playback, and review the coding session by viewing an animation of the entered codes.

MAS TOOLS supports identifying points of interest and configuring connections between points. Each point and each connection may be identified with a separate detectable color. After analysis, the system will calculate displacement, acceleration, and velocity.

Comments: MAS TOOLS appear more ergonomically based then work measurement based. It could be useful in development of work and time standards but is not directly applicable to the scope of the survey and not shown in the review tables.

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DO-0121   24 March 1997

Company: EASE, Inc.
                710 Fehr Road
                Louisville, KY 40206
                (502) 894-8830

POC: Kurt D. Maddox

Product: EASE

Description: EASE is MIL-STD 1567A Compliant. EASE provides support for work
                measurement, cost estimating, process planning, line balancing, and
                ergonomics. EASE is provided in modules for:
                • methods engineering and labor time standards.
                • engineering data for electronic assembly, welding, sheet metal, and
                others
                • machine planning with speed and feed recommendations
                • cost estimates and management reports
                • computer aided process planning (CAPP)
                • line balancing
                • ergonomics
                • shop floor display

Comments: As shown above EASE is a modular system. The module of most
                interest is the Core Module. The Core Module supports the work
                definition and time calculations. The Core Module looks like a good
                application for developing standards times from predetermined times, and
                has similar functionality to MOST for Windows. The Core Module
                supports the development of standard elements that are comprised of
                EASE Macros. PF&D allowances and planning factors can be included if
                needed.

                The Core Module allows the development of processes for a given part
                number. The processes are comprised of Operations which are
                comprised of Standard Elements.

                EASE supports the attachment of text, multi-media, and graphics to
                processes to help in the work definition. The demo showed the built-in
                capability to view a video (avi file) while constructing the processes.

DO-0121

24 March 199⁻

Company: Royal J. Dossett Corp..
2795 Pheasant Rd
Excelsior, MN 55113
(612) 471-8203

POC: Royal J. Dossett

Product: FAST

Description: FAST for Windows is a comprehensive five level work standards system, supporting Motions(0), Macros(1), Elements(2), Operations(3), and Routers (4). FAST supports the Predetermined Motion Time (PMT) system call MST Motion Standard Times to define the Level 0 "Motions." Each MST word-code has a corresponding toolbar button for fast development. Distances are in ranges of 1, 2, 6, 12, 18, 32 inches. Weight is in pounds. (FAST is optionally available with MST in centimeters and kilograms.)

A development/cross reference chart to MTM-1, MTM-2, MSD, and MODAPTS is included in the FAST instruction manual. MST is generic, and intuitive, and can be self-learned from the instructions accompanying FAST. In addition, it is easy to interpret by others. MST has been placed in the public domain to ensure continued use and support.

Macros are constructed from Motions. Elements are constructed from Macros and Motions. Operations are constructed from Elements, and Routers are constructed from Operations. Times are entered as "Constant", "Table", or "Equation". The Operations level is where worker standards are developed from standard data elements. Set-up, Total, and Allowance times are supported at this level as well as up to 99 workers per operation. Summary data may also be added to the operation, e.g., Cycles Per lot, or Lots Per Move, or Dollars Per Piece. Routers combine operations to produce product standards. FAST Routers can be used by a formal router system.

Comments: If the operation and usability of FAST is true to the product literature it looks like a nice package to support a five level system. Other packages discussed Operations, Elements, and Macros, but none as well as FAST. FAST also talks about Motions and Routers. Some Packages may do the Motion level for you from Marco codes.

Product: TimStudy

Description: This computerized time study software uses the Datawriter data collector and the user's personal computer. The user divides the task to be studied into elements with assigned numbers (1,2,3..) and saves the file as an "I-File." Then the time study is taken using the "DataWriter or computer system. Element number and rating factors are entered for each element timed and the resulting data stored on the computer as an "F-File." Reports are then generated using the "I" and "F" files.

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Comments: Mr. Dossett said that DoD has a CATS system, and he believes it was developed by Harry Deshields.
See: C.A.T.S., and "The RateSetter".

Product: WorkSamp

Description: WorkSamp is a program for summarizing work sampling studies taken on the Datawriter data recorder. Computerized, observed, and self-taken. It uses the Datawriter and personnel computer.

Comments: WorkSamp appears to work like TimStudy, except that it does work sampling.

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E.3. ANALYSIS AND EVALUATION

E.3.1 Analysis and Evaluation Method

As discussed above, this is a high level analysis of available COTS packages as compared to the WSAP requirements.

For each application listed, the providing organization was called and the scope of the project discussed. Based on that discussion the organization provided applicable data about their product. Due to time constraints and the broad scope of the requirements evaluation, copies of the applications were not requested. The received data was analyzed against the requirements and appropriate notes taken. If there were questions regarding the functions of an application, the POC for that application was called and further discussions held.

The primary goal is to show how each COTS package supports the requirements. To do this we have chosen to use a set of matrices that list the requirements across the top and the COTS packages down the side. Each COTS package was reviewed and a determination was made as to how well the product could support the requirement(s). Each application has been ranked from 0 to 3 indicating its ability to support the associated requirement(s).

        0..........Little or no ability to satisfy the requirement(s))

        1..........Good ability to satisfy the requirement(s)

        2..........Better ability to satisfy the requirement(s)

        3..........Best ability to satisfy the requirement(s)

The following chart is illustrates the matrix format.

	Reqt 1	Reqt 2	Reqt 3	Reqt n
COTS 001	ranking #		ranking #	
COTS 002		ranking #		
COTS 003			ranking #	
COTS 00n	ranking #	ranking #		ranking #

E.3.2 Analysis and Evaluation Results

The following tables show the results of the review and analysis performed on the data received from each COTS vendor.

E.3.2.1 Work Processes

Work Processes Requirements	WP 1 Id Units Of Work	WP 2 Id & measure Unit Of Work products	WP 3 Roll up of Unit Of Work measures	WP 4 Associate performance data with Unit Of Work	WP 5 I/O to performance improvement tasks	WP 6 Maintain/ update WBS	WP 7 New WBS "Pick-N-Plug"
Resource Planner	2	1	1	0	1	1	2
CATS	2	0	0	0	0	0	0
Visual Manufacturing	3	0-1	0-1	1	1	2-3	3
RateSetter	1	0	0	0	0	0	0
Time Quest Study Taker	2-3	2	3	0	0	0	1
Time Quest Data Manager	2-3	2	3	0	0	0	1
ProRep	3	0	1	2	0	1	1
MOST	2	1	1	0	0	0	0
MOST Data Manger	2	1	1	0	0	0	0
ADAM	2	0	0	0	0	0	2
MTM-LINK	2	0	0	0	0	0	2
OCS TOOLS	1-2	0	0	0	0	0	0
EASE (Core)	1-2	0	2	0	0	1	1
FAST	2-3	0	0	0	0	1	1
TimStudy	1	0	0	0	0	0	0
WorkSamp	1	0	0	0	0	0	0

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E.3.2.2 Target Time

Target Time	TT 1 Supports standard time equation	TT 2 Document work flow times	TT 3 "What If"	TT 4 Roll Up	TT 5 Predetermined times	TT 6 Manpower link	TT 7 Maintain and update
Resource Planner	2	2	1	2	2	0	2
CATS	0	1	0	0	0	0	1
Visual Manufacturing	0	2-3	2-3	2-3	0	0	2-3
RateSetter	0	1	0	0	0	0	0
Time Quest Study Taker	2-3	2	2	2-3	3	0	3
Time Quest Data Manager	2-3	2	2	2-3	3	0	3
ProRep	0	1	0	3	0	0	3
MOST	0	2	0	2-3	3	0	2
MOST Data Manger	0	2	0	2	3	0	2
ADAM	2	0	0 ·	0	3	2-3	2
MTM-LINK	2	0	0	0	3	0	2
OCS TOOLS	0	1	0	1	0	0	0
EASE (Core)	0	1	0	1-2	3	2	2
FAST	3	2	1	3	3	0	2-3
TimStudy	0	1	0	0	0	0	0
WorkSamp	0	1	0	0	0	0	0

E.3.2.3 Total Manpower

Total Manpower	TM 1 Record all types of man-power	TM 2 Automate operational audits	TM 3 Document results	TM 4 Staffing factors and formulas	TM 5 Standard labor ratios	TM 6 New manpower "Pick-N-Plug"	TM 7 Programmable relationships	TM 8 Roll-up	TM 9 Maintain and update
Resource Planner	0	0	0	0	0	0	0	0	0
CATS	0	0	0	0	0	0	0	0	0
Visual Manufacturing	1	0	1	2	0	1	1	1	1
RateSetter	0	0	0	0	0	0	0	0	0
Time Quest Study Taker	0	0	0	0	0	0	0	0	0
Time Quest Data Manager	0	0	0	0	0	0	0	0	0
ProRep	0	0	0	0	1	0	0	0	0
MOST	0	0	0	0	0	0	0	0	0
MOST Data Manger	0	0	0	0	0	0	0		
ADAM	2	0	0	2	1	2	1	2	1
MTM-LINK	0	0	0	0	0	0	0	0	
OCS TOOLS	0	0	0	0	0	0	0	0	0
EASE (Core)	0	0	0	0	0	0	0	0	0
FAST	0	0	0	0	0	0	0	0	0
TimStudy	0	0	0	0	0	0	0	0	0
WorkSamp	0	0	0	0	0	0	0	0	0

E.3.2.4 General Capabilities

General Capabilities	GC 1 Service wide work standards support	GC 2 WBS Interface with management systems	GC 3 "Actuals" Interface with management systems
Resource Planner	2	2	0
CATS	1	0	0
Visual Manufacturing	2-3	2-3	2-3
RateSetter	0	0	0
Time Quest Study Taker	2	0	0
Time Quest Data Manager	2	0	1
ProRep	0	1	2
MOST	2	0	0
MOST Data Manger	2	1	0
ADAM	2	1	0
MTM-LINK	2	1	
OCS TOOLS	1	0	0
EASE (Core)	1	1-2	0
FAST	2	1	0
TimStudy	1	0	0
WorkSamp	1	0	0

E.4. WORK MEASUREMENT TECHNIQUES SUPPORTED

COTS / Techniques of Motion Study	Resource Planner	CATS	Visual Manu-facturing	Rate Setter	Time Quest Study Taker	Time Quest Data Manager	Auto MOST	MOST	MOST Data Manager	Assembly Manager	Ergo MOST
1. Possibility Guides											
2. Work-Unit Analysis	X	X		X	X	X		X	.		
3. Work Activity Analysis and Work Sampling			.					X			
4. Process Chart-Product Analysis											
5. Horizontal Time Bar Charts			X								
6. Network Diagrams											
7. Motion Economy											
8. Chart-Person Analysis											
9. Information Flow Analysis											
10. Operation Charts and Robot Analysis			.								
11. Multiple Activity Charts											
12. Quality Control			X		.						
13. Photographic & Electronic Data Recording		X		X	X						
14. Micromotion and Memotion Analysis											

COTS / Techniques of Motion Study	ProRep	Data Import	MTM-UAS	MTM-MEK	ADAM	MTM-LINK	OCS TOOLS	MAS TOOLS	EASE	FAST	Tim Study	Work Samp
1. Possibility Guides												
2. Work-Unit Analysis									X	X	X	
3. Work Activity Analysis and Work Sampling							X		X	X		X
4. Process Chart-Product Analysis												
5. Horizontal Time Bar Charts												
6. Network Diagrams												
7. Motion Economy												
8. Chart-Person Analysis												
9. Information Flow Analysis												
10. Operation Charts and Robot Analysis												
11. Multiple Activity Charts												
12. Quality Control												
13. Photographic & Electronic Data Recording							X	X	X	X	X	X
14. Micromotion and Memotion Analysis								X				

COTS / Techniques of Time Study and Work Measurement	Resource Planner	CATS	Visual Manu-facturing	Rate Setter	Time Quest Study Taker	Time Quest Data Manager	Auto MOST	MOST	MOST Data Manager	Assembly Manager	Ergo MOST
1. Direct Time Study -Intensive Sampling		X		X							
2. Direct Time Study - Extensive Sampling											
3. Developing Skill at Rating Time Studies											
4. Predetermined Time Studies	X							X	X		
5. Standard Data Systems		X		X	X	X					
6. Computer-Assisted Standard Times	X		X								
7. Fractionated Professional Estimate	X		X								
8. Time Standards by Fiat	X		X								
9. Time Standards by Mathematical Analysis			X								
10. Measuring the Productivity of a Manufacturing Organization											
11. Measuring the Productivity of a Service Organization											

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COTS Techniques of Time Study and Work Measurement	ProRep	Data Import	MTM-UAS	MTM-MEK	ADAM	MTM-LINK	OCS TOOLS	MAS TOOLS	EASE	FAST	Tim Study	Work Samp
1. Direct Time Study - Intensive Sampling										X	X	
2. Direct Time Study - Extensive Sampling												X
3. Developing Skill at Rating Time Studies												
4. Predetermined Time Studies					X	X			X	X		
5. Standard Data Systems												
6. Computer-Assisted Standard Times										X	X	X
7. Fractionated Professional Estimate												
8. Time Standards by Fiat												
9. Time Standards by Mathematical Analysis												
10. Measuring the Productivity of a Manufacturing Organization	X											
11. Measuring the Productivity of a Service Organization	X											

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E.5. CONCLUSIONS

From the initial review of COTS software it seems that there are very good packages available that are currently meeting the needs of commercial organization. A portion of these packages allow for "Work Measurement" using timing devices or video technology. Others define the operations and use predetermined times based on the motions or operations described, or allow the recorded times to be used. These operations are then associated with workstations and personnel to define the physical work environment to assist in planning. The planning tools were geared towards "Line Balancing".

Of the packages reviewed, Visual Manufacturing looks to be a possible "Standard System" when supported by one or more "Standard Time" interfaces. An outstanding aspect of Visual Manufacturing is that it manages with the same process structure to which times are assigned.

The MIL-STD 1567A compliant packages are EASE, MODAPTS, MTM-UAS, and MTM - MEK.

E.5.1 Work Processes

The majority of the COTS packages reviewed supported Work Process description. However, the work processes were for the purpose of attaching time values or notional data for target time development. There was no indication that any additional data could be attached to the activity and "rolled-up".

ProRep was the only package reviewed that dealt with reporting actuals (time and production values) with processes for productivity calculation.

Only "Visual Manufacturing" links the work processes to a WBS for production. Other packages are geared more towards using the work process to lay out work cell and assembly lines for balancing.

E.5.2 Target Time

There were three categories of COTS packages review; 1) packages that recorded times, 2) packages that used those times or notational times to provide "Target Times", or 3) packages that just used the times. The major "Target Time" development packages are primarily notational packages. These packages define the processes in a series of codes or action phrases. These codes and phrase have predefined time values associated with them whereupon the "Target Times" are then calculated.

E.5.3 Total Manpower

The majority of the COTS packages reviewed did not support manpower calculations or projections based on workload. However, ADAM by MTM Association does purport to calculate manpower by skill level for a given workload.

E.5.4 General Capabilities

Of the products reviewed, Visual Manufacturing has the best general capability support. Most of the packages provided work standards support and some WBS support. The best manpower package was ADAM followed by Visual Manufacturing.

E.5.5 Lessons Learned

The general nature of the requirements made assigning precise weighting and answers more difficult. A more refined and separated list of requirements will facilitate better communications with the COTS representatives. When the requirements are refined, and if another COTS review is conducted, it may be a good idea to develop a survey for the COTS representatives. This survey may look very much like chart in section 3 of this appendix. The vendor would fill out the survey when evaluating a product against an acquisition requirement. Such charts would have the vendor rate the ability of their product to satisfy a requirement or, if it does not, determine if the product can be adapted to satisfy the requirement. This would facilitate a better understanding of the requirements and allow the COTS representative to provide more detailed answers.

APPENDIX F - ACRONYMS

A

ABC	Activity Based Costing
ACPERS	Army Civilian Personnel System
AFCQMI	Air Force Center for Quality and Management Innovation
AFMC	Air Force Materiel Command
AIS	Automated Information System
AFMEA	Air Force Management Engineering Activity
AMAA	Army Manpower Analysis Agency
AMC	Army Material Command
AMCMEA	Army Material Command Management Engineering Activity
APCAPS	Automated Payroll, Cost Accounting, and Personnel System
AQL	American Quality Leadership
ASIP	Army Stationing Inventory Plan

B

BAIM	Baseline Advanced Industrial Management
BPR	Business Process Re-engineering

C

CAMIS	Commercial Activity Management Information System
CATS	Computer Aided Time Standards; Computer Assisted Time Study
CFO	Chief Financial Officer
CINC	Commander-In-Chief
CINCLANTFLT	Commander-In-Chief Atlantic Fleet
COTS	Commercial Off-The-Shelf
CPU	Computer Processing Unit

D

DBMS	Defense Business Management System

DCMC	Defense Civilian Manpower Center
DDRV	Defense Depot, Richmond, VA
DEIS	Defense Enterprise Integration Service
DIESS	Defense Industrial Engineering Support System
DII COE	Defense Information Infrastructure Common Operating Environment
DISA	Defense Information System Agency
DISN	Defense Information Systems network
DLA	Defense Logistics Activity
DMDC	Defense Manpower Data Center
DMMIS	Depot Maintenance Management Information System
DMS	Depot Maintenance System
DoD	Department of Defense
DPES	Defense Performance Engineering Support
DPPI	Defense Productivity Process Improvement
DPSO	Defense Productivity Support Office
DPU	Defense Performance Unit
DSS	Distribution Standard System; Decision Support Systems

E

EC/EDI	Electronic Commerce/Electronic Data Interchange
EDI	Electronic Data Interchange
EIS	Executive Information System
ELS	Engineering Labor Standards
EPS	Engineered Performance Standard
ER	Efficiency Review

F

FACTS	
FEO	For Exposition Only
FPI	Functional Process Improvement
FTE	Full Time Equivalent; Factory Test Equipment

G

GAO	Government Accounting Office
GC	General Capabilities
GCCS	Global Command and Control System
GCSS	Global Combat Support Systems
GFI	Government Furnished Information
GOTS	Government Off-The-Shelf
GPRA	Government Performance Review Act

H

HQ	Headquarters

I

IE	Industrial Engineer
INFOSEC	Information Security
IG	Inspector General

J

JLSC	Joint Logistics Service Center

K

L

LAN	Local Area Network
LAPERS	Labor and Personnel System
LMI	Logistics Management Institute

M

MA	Management Analyst
MAJCOM	Major Command

MDR	Master Data Record
ME	Management Analyst/Engineer
MEO	Most Efficient Organization
MOE	Minimum Operating Equipment; Measure of Effectiveness
MOS	Manpower Operation Specialty; Military Occupational Specialty
MRP	Manufacturing Resource Planning
MRP II	Manufacturing Resource Planning II
MTM	Methods Time Measurement

N

NADEP	Naval Aviation Depot
NASA	National Aeronautics and Space Administration
NAVAIR	Naval Air Systems Command
NAVDEP	Naval Depot
NAVMAC	Navy Manpower Analysis Center
NAVSEA	Navy Sea Systems Command
NPR	National Performance Review

O

OFI	Opportunities for Improvement
OPR	Office of Primary Responsibility
OSD	Office of the Secretary of Defense

P

P&R	Personnel and Readiness
PBD	Program Budget Decision
PBG	Planning Budget Guidance; Program Budget Guidance
PCS	Production Control System
PDMSS	Programmed Depot Maintenance Scheduling System
PE	Performance Engineering; Performance Engineers
PECI	Productivity Enhancing Capital Investment

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PF&D   Personal, Fatigue and Unavoidable Delay

POM   Program Objectives Memorandum

PPBS   Planning, Programming and Budgeting System

PROGE

Q

R

ROC/POE   Required Operational Capability/Projected Operational Environment

ROM   Rough Order of Magnitude

S

SAMAS   Structure and manpower Authorization System

SDS   Standard Depot System

SHORLANT   Shore Atlantic Command

SIROC   Shore Installation Required Operational Capability

SME   Subject Matter Experts

SOP   Standard Operating Procedure

SPC   Statistical Process Control

ST   Standard Time

T

TAADS   The Army Authorization Documentation System

TAFIM   Technical Architecture for Information Management

TFMMS   Total Force Management System

TM   Total Manpower

TQM   Total Quality Management

TRM   Technical Reference Model

TT   Target Time

U

USA	United States Army
USAIFSA	U.S. Army Force Integration Support Agency
USD	Under Secretary of Defense

V

VMRS	V Manpower Readiness System

W

WAN	Wide Area Network
WBS	Work Breakdown Structures
WBS/TC	Work Breakdown Structure/Task Codes
WC	Work Count
WCS	Workload Control System
WINPAT	
WM/LS	Work Measurement/Labor Standards
WMS	Work Measurement Standards
WM/WS	Work Measurement/Work Standards
WP	Work Processes
WS	Work Standard(s)
WSAP	Work Standards Application Package
WT	Work Times
WWW	World Wide Web

X, Y, Z

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